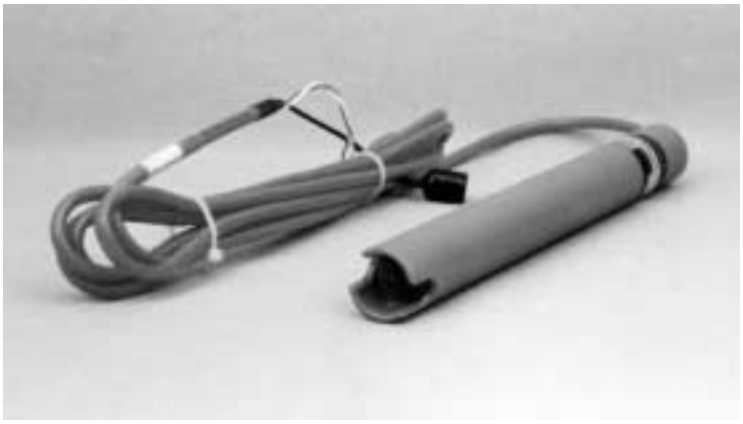
INSTRUCTION MANUAL

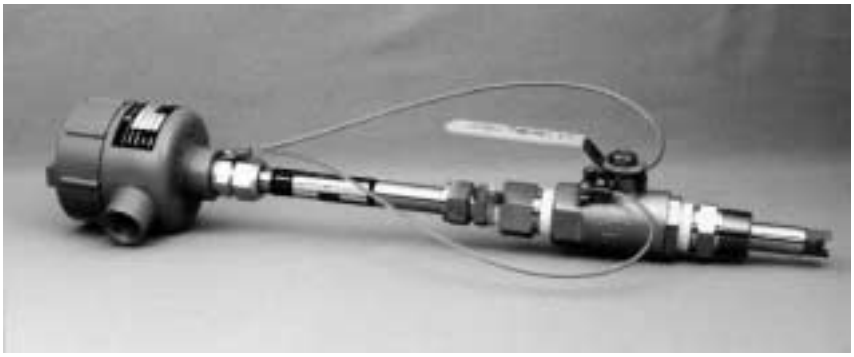
pH SENSOR

617 High Pressure Ball Valve Retractable



642 Industrial Combo "One of the World's most rugged pH"

625 UNIVERSAL



605 for the strength of SS; insertion or ball valve

615 Pure Water pH

606 SS Blowout Stop BV

602 Light Combo

IC CONTROLS

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pH Measurement

What is pH?

pH is a short form for the Power (p) of Hydrogen (H)

pH is defined as the negative log of the Hydrogen ion activity, aH^+ or the effective hydrogen ion concentration.

Mathematical Definition

$$pH = Log_{10} \frac{1}{aH^+} = -Log_{10} aH^+ \quad \text{(Theoretical)}$$

+

$$pH = Log_{10} \frac{1}{[H^+]} = -Log[H^+] \quad \text{(Practical)}$$

Descriptive Definition

pH is a unit of measure which describes the degree of acidity or alkalinity of a solution. Acidity is defined as the concentration of hydrogen ions [H+] in solution and alkalinity as the concentration of hydroxyl ions [OH-] in solution. As seen above the actual theoretical definition of pH is -Log10 aH+. But, since the activity coefficient (a) for hydrogen (H+) is 1 the practical definition for pH can then be defined as -Log10 [H+]. Below is a chart showing the relationship between pH and the Hydrogen ion concentration.

pH Measurement Techniques

There are two ways of measuring pH. The first is a Colorimetric Method which uses color indicators to indicate the pH of the sample. There are limitations to this measurement technique. For instance, visual measurement by an operator is subject to variation. As well, this technique is done by grab sample which is not suitable for continuous on line measurement.

A more effective way to measure pH in an industrial setting is the potentiometric method of pH analysis. The potentiometric method allows continuous, on-line measurement and is not subject to operator bias. Potentiometric analysis has four parts: 1) sample, 2) pH sensing electrode, 3) reference electrode and 4) signal amplifier/readout. When properly combined the result is accurate, representative pH readings.

pH Sensing Electrode

The pH sensing electrode acts as one half of a battery whose potential varies with the hydrogen ion concentration in solution. The Standard Glass Electrode is commonly used in industrial applications because of its ruggedness and versatility. Finally, there are other Solid State Electrodes such as the Antimony Electrode which is a sensing element made of Antimony Hydroxide and is used in applications, like high fluoride, where glass is dissolved.

pH = HYDROGEN ION CONCENTRATION

pH	Hydrogen Ion Moles per Litre (H^+)		**Hydroxyl Ion Moles per Litre (OH^-)**	
0	(10^0)	1	0.00000000000001	(10^{-14})
1	(10^{-1})	0.1	0.0000000000001	(10^{-13})
2	(10^{-2})	0.01	0.000000000001	(10^{-12})
3	(10^{-3})	0.001	0.00000000001	(10^{-11})
4	(10^{-4})	0.0001	0.0000000001	(10^{-10})
5	(10^{-5})	0.00001	0.000000001	(10^{-9})
6	(10^{-6})	0.000001	0.00000001	(10^{-8})
7	(10^{-7})	0.0000001	0.0000001	(10^{-7})
8	(10^{-8})	0.00000001	0.000001	(10^{-6})
9	(10^{-9})	0.000000001	0.00001	(10^{-5})
10	(10^{-10})	0.0000000001	0.0001	(10^{-4})
11	(10^{-11})	0.00000000001	0.001	(10^{-3})
12	(10^{-12})	0.000000000001	0.01	(10^{-2})
13	(10^{-13})	0.0000000000001	0.1	(10^{-1})
14	(10^{-14})	0.00000000000001	1	(10^0)

THE GLASS ELECTRODE

Since the glass electrode is still the industry standard for sensing electrodes it will be the only sensing electrode discussed.

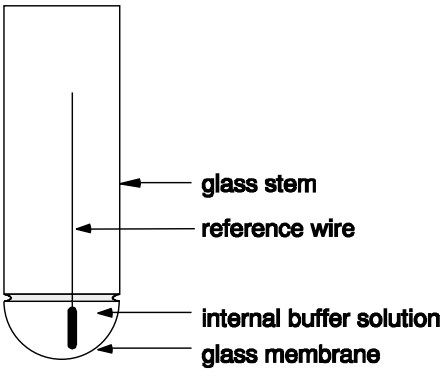


Figure 1 GLASS pH ELECTRODE

The glass electrode basically consists of four major components: 1) the glass membrane, 2) the internal buffer solution, 3) the reference wire and 4) the glass stem. Fig. 1

How Glass Electrodes Work

The glass electrode it is primarily composed of alkali silicates which are comprised of Sodium, Potassium, Lithium, Silica, Oxygen and Hydrogen. All of these components are combined to form a Hydrogen ion specific sensing glass; the amount of each constituent in the glass determining its pH sensing properties.

When the glass is put into solution it undergoes a chemical reaction which forms of a leached layer. The leached layer is the area at the surface of the glass where an ion exchange reaction takes place. In this surface layer Hydrogen ions migrate in and replace other positively charged ions such as Sodium or Potassium. This causes a Silica-Oxygen-Hydrogen bond to be set up which is essential for sensing Hydrogen ion in solution.

The pH glass electrode actually works on a two reference electrode basis, a reference inside the glass and a reference that is in contact with the externals of the glass. pH measurement requires measurement of the potential difference in the pH electrode system. The formation of a leached layer actually occurs on both sides of the glass membrane. The difference in potential between the two layers is called the Phase Boundary Potential and is the potential difference that gives the pH signal.

In the pH glass there must also be a charge transport mechanism so that a millivolt potential will be seen. In between the two leached layers there remains a glass membrane layer that does not undergo the ion exchange that occurs at the surface. In this membrane layer Potassium and Sodium, major constituents of the glass, act as the charge carriers.

For best results a Symmetrical Cell is set up on both sides of the glass membrane. To set up the Symmetrical cell the internal fill solution in the glass and the reference fill solution are similar in their makeup. The symmetry is important so that the temperature curves for the two solutions are as close as possible and minimize the temperature effect. For Symmetry purposes the internal buffer is made of KCl (Potassium Chloride) solution which is the same as the reference solution.

Styles of Glass Electrodes

The basic premise behind glass pH electrodes is to have the reference and the Hydrogen Ion sensitive glass membrane in contact with the solution being monitored. The glass membrane itself is not limited to any configuration or shape; its only requirement is contact with solution. Therefore, different styles of

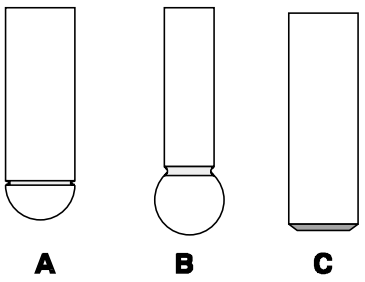


Figure 2 A) Dome B) Spherical C)

glass electrodes have evolved to maximize pH sensing ability and extend longevity in some of the more rugged applications. Below are some of the common styles of glass presently available.

Temperature Effect on Glass

As the charge transfer is one of the key factors in determining pH, the conductivity of the internal layer of the glass is a factor in the responsiveness of the electrode. The more conductive the glass is, the quicker the potential difference will be transferred across the membrane. Thicker, ruggedized styles of glasses are slower to respond in ambient conditions than general purpose electrodes, because it takes longer to transfer the charge and set up the difference between the Leached Layer Potentials.

The conductivity of the glass, which is the reciprocal of resistance, is highly temperature dependent, as seen in the following equation, where k is the conductivity and A and B are constants:

$$-\text{Log}k = A + \frac{B}{T}$$

From this equation it is evident that as the temperature increases the conductivity of the glass also increases, which explains why thick glasses, which are somewhat sluggish at ambient temperatures, will be very responsive when the temperature of the sample is increased. Fig. 3, is a graph that illustrates this relationship between temperature and the conductivity of the glass for a standard glass membrane.

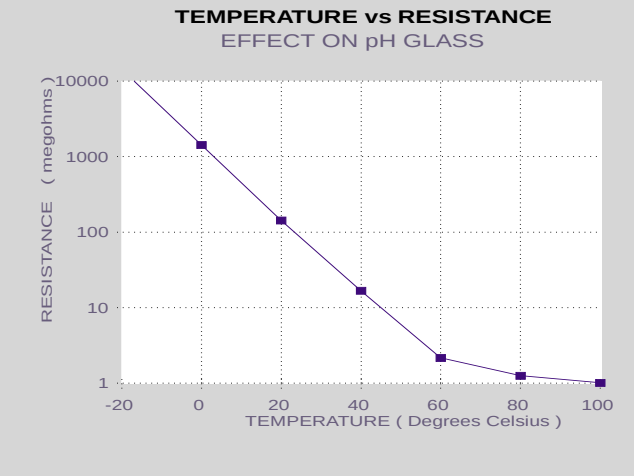


Figure 3 pH Glass Resistance vs

Because of the temperature effect on the impedance of the glass, a thinner glass with a low impedance is used in ambient conditions, and a thicker more rugged glass with a higher initial impedance is used for high temperature applications.

Therefore, when selecting a glass electrode for industrial pH systems a number of different factors must be considered to maximize response and longevity of the probe in your application.

The Reference Electrode

The reference electrode acts as the other half of the battery in the pH electrode. The difference in potential between the two sides of the pH glass measures the varying potential difference in the solutions due to pH. Where the reference is constant it gives the glass a reference point to use for the glass electrode to distinguish that pH relates to the process pH potentials.

As mentioned in the glass section, the best results for an electrode occur when the two sides are symmetrical. Thus, a reference cell normally is comprised of a Silver wire with the tip of the wire covered in Silver Chloride. This Silver\Silver Chloride wire is submersed in a saturated KCl solution which is separated from the process by a porous junction.

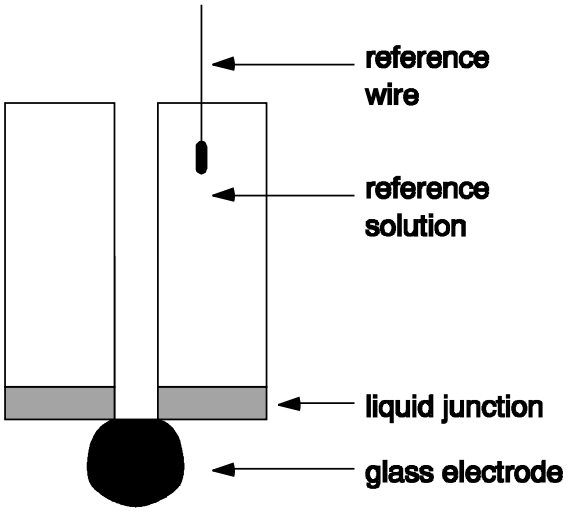


Figure 4 Combo electrode with Ag/AgCl

A diagram of a typical combination electrode with a Silver/Silver Chloride reference is seen below.

Like the glass electrode there are also different types of reference electrodes that can be utilized in any given pH measurement. The two common references are the Calomel electrode and the Silver/Silver Chloride reference. The Calomel electrode is not used in industrial applications for two reasons. First, the electrode tends to break down when the temperature exceeds 80°C or 175°F. As well, the Calomel electrode is partially comprised of Mercury, which is known to be a health hazard thus making it less user friendly than the Silver/Silver Chloride reference.

The Silver/Silver Chloride reference has a number of advantages for use in the industrial pH market. First, the temperature stability of this reference is good in applications ranging up to 105°C (220°F). But when stabilizers are added to the reference, accurate pH measurements can be taken to temperatures in excess of 125°C (260°F). With the stability of this reference and the relative ease of manufacture into a combination electrode the Silver/Silver Chloride reference has become IC Controls standard.

Reference Junction Impact

The Silver/Silver Chloride reference has a porous junction between KCl reference solution and the process. This porous junction acts as a barrier to keep the reference internals and the process from readily mixing and contaminating the reference, which would render the reference useless.

Like the glass membrane, the junction can cause a noticeable potential difference in the electrode. The difference in the magnitude of this potential is small in comparison to the glass, but it is significant enough that choosing the proper junction can have an effect on the pH measurement. In considering which junction is used for an electrode the chemical compatibility of the reference junction material with the process must also be considered.

Ceramic Junctions

In the industrial pH electrode there are basically three styles of reference junctions that can be selected: ceramic, wood or porous plastic, depending on the process application. The first is the Ceramic junction which is very useful in high accuracy types of pH measurements because of its low junction potential. There are a couple of limitations with this junction, though. The junction usually has very little surface area in contact with the process, making it prone to clogging, especially in dirty or oily industrial applications. As well, because of the brittle nature of ceramic, it is less shock resistant in applications where the electrode comes in contact with small rocks or pieces of debris on a regular basis. For these reasons the ceramic junction is primarily used in the laboratory for grab sample purposes where high accuracy is required and the electrode will not be subject to the rigors of the process.

Wood Junctions

Another type of junction that can be used with IC Controls pH electrodes is the Wood junction. Wood, by its nature, allows good transport of liquid through its fibers and resists coating from most substances. These two features make the wood junction exceptional for use in applications where coating from the process can occur. IC Controls wood junctions are normally manufactured with a larger surface area which allows for better contact with the process, which is essential in the dirtier applications that try to clog the reference junction. The limitation of wood occurs in high temperature and high pH environments.

Porous Plastic

For high temperature and high pH applications a Porous Plastic junction is used because it is chemically resistant and is not affected by temperature in the readable temperature range of pH. Like wood IC Controls porous plastics are manufactured with large surface areas so that good solution contact is maintained. If an application is running over 50^{o}C or above pH 8 continuously, a porous plastic junction may provide best results.

pH Concerns in Industry

In the industrial pH application there are a number of different problems that are common and cause difficulties when trying to measure pH. Below is a list of some of the most common pH measurement dilemmas and how to approach them to get better results.

Slope and Offset

The slope and offset are measures of how efficient and how close to theoretically perfect the probe is.

When a calibration is done the first step is to use pH 7 buffer to calculate the mV offset of the electrode from the theoretically perfect 0 mV. A larger mV offset is farther from a theoretically perfect electrode. pH 7 buffer is used because it simulates 0 mV thus making it the best standard to calculate the offset from this 0 mV reference point.

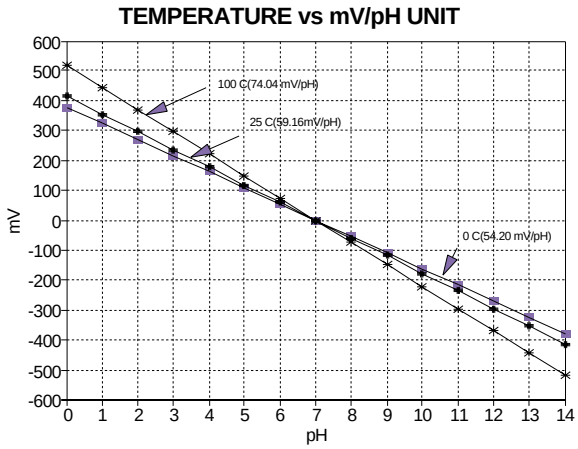
The next step in the calibration is to use a second buffer (usually 4 or 10). Either of these buffers gives a large enough space relative to the pH 7 buffer that a good slope can be calculated. When calculating the slope of the electrode a good separation between the buffers is needed so that an accurate span between two points is calculated. As well, when choosing which buffers to use in calibration it is best to choose buffers that fall on both sides of the normal operating pH. By using these two buffers the slope calculation will encompass the normal pH, thus giving the most accurate pH measurement. At 25^{o}C the slope is 59.16 mV per pH unit and the slope is measured as a percentage of this millivoltage. When performing the two point calibration a percent value will be given in microprocessor based pH analyzers. The closer to 100% the slope is the better the efficiency and thus the performance of the electrode.

Heat Effect on Slope

At 25^{o}C the slope of a 100% efficient probe is 59.16 mV per pH unit with 0 mV starting at pH 7. But, as the temperature changes, so does the mV per pH unit as seen below in the graph. In fact, the slope changes 0.1984 mV per degree Celsius.

This relationship is important in determining pH. If it is not used the reading could be out a significant amount.

For example: pH is being monitored in a process at pH 4 and 60°C. The output from the probe will be



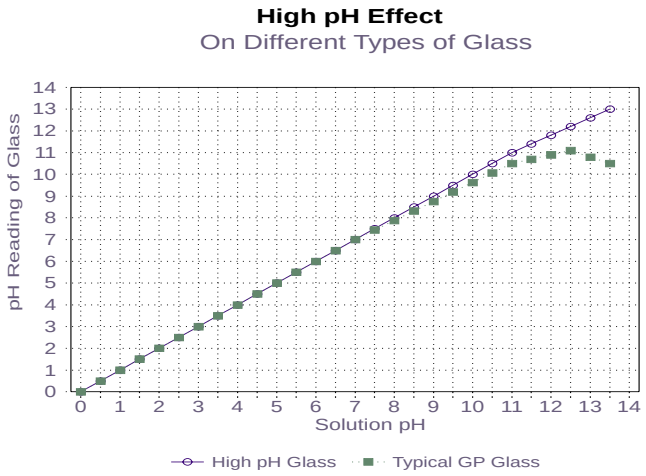
198 mV according to the temperature to mV relationship. If the analyzer does not use temperature compensation it will see 198 mV and assume this reading is taken at 25°C. At 25°C, 198 mV is calculated by the pH meter at 59.16 mV per pH to be a pH of 3.64 which is off by a third of a pH unit lower than 4.0.

Therefore, it is important to ensure that temperature compensation is used in the pH probe and that it is working properly so that accurate pH readings are given by the analyzer.

Caustic Ion Error

Another problem with pH electrodes occurs at the high end of the pH scale when the concentration of Hydrogen ions is low. In fact, high pH causes two problems. First, at high pH there is a high hydroxide (OH^-)concentration coupled with extremely low hydrogen ion which will dehydrate the glass making it very sluggish in responding to pH changes.

Secondly, and more importantly, a caustic (sodium) ion error will occur if the proper glass is not used. As the pH goes up, the concentration of Hydrogen ion goes down. At the same time the concentration of Sodium ion will increase. Sodium is very close to Hydrogen in its chemical structure. As the concentration of Hydrogen ion decreases the glass will start to recognize Sodium as Hydrogen, thus giving a false, low pH reading. By using high pH glass the Sodium ion error will be negated as seen in the graph below.



This graph shows that using the proper glass can have a significant effect on the accuracy of the pH reading. One other benefit to this high pH glass is its resistance to caustic etching. Thus, using high pH glass will result in improved performance and longevity will be seen.

Coating of the Glass

In a number of applications there are constituents that will coat the glass, such as Calcium carbonate which is present in systems where lime addition is used for effluent neutralization. Coating of the glass causes poor contact between the glass itself and the process. Good contact by the electrode is essential for accurate speedy response in the process. Thus, to help keep the glass clean and responsive there are a couple of procedures that can be used to help.

The first is to insert the electrode with the flutes at 75°

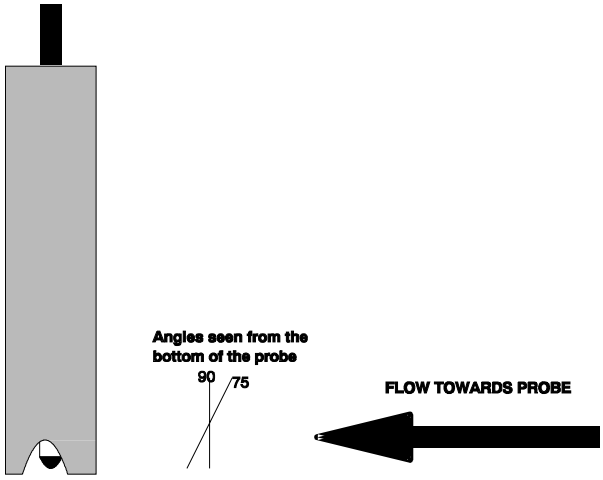


Figure 5 Angle flutes to create a vortex

to flow, as seen in the diagram below. By inserting the probe at this angle a vortex will be created around the glass. The vortex will increase the velocity of the

process around the glass and reference which will, in turn, hasten electrode response time and also keep the reference cleaner. As well, by turning the flutes to 75^{o} the process does not directly hit the glass which will slow down the coating action.

When the probe does coat, a good cleaning procedure should be used to restore the electrode back to 100%.

In the past a Hydrochloric acid solution was used to remove scale from the tip of the electrode. Although this has been somewhat effective, a gentle scale remover will better clean the electrode. If the pH response becomes sluggish and the slope of the probe starts to get too low, an electrode renew solution can be used. The electrode renew solution will skim off a micro-layer of the coated glass, thus exposing a new glass surface which will exhibit better pH response.

Ground Loops

One of the more difficult problems to analyze in a pH loop is a ground loop which does not necessarily exhibit any visual signs. Unlike scaling or even Caustic ion error, which you specifically look for at high pH's, a ground loop can occur at any pH under many different conditions. Fortunately, there are certain indicators that point to a ground loop problem.

First of all it is important to know what causes a ground loop . A ground loop occurs when an external charge is applied to the pH system. When analyzing for a ground loop look for a pH offset in the process pH reading, compared to a grab sample pH reading taken in a beaker, just after the electrode has just been calibrated.

As an example , a ground loop can occur if an electrode is inserted into a pipe that is carrying a charge which is then transferred by a short to the pH probe, or, in a charged process the pH reference cell can act like a ground wire and current will flow through it to any ground. Therefore, to alleviate a ground loop problem an isolated reference input plus a ground wire or a solution ground is used to bleed off the residual charge, keeping the mV seen by the analyzer isolated to the potential produced by the pH reading itself.

Reference Contamination

In different processes there are a number of different constituents that can contaminate the reference electrode. Some constituents migrate into the reference and attack the Silver\Silver Chloride reference wire causing the wire to deteriorate over time. The reference offset is a gauge of how far the deterioration of the reference electrode has progressed. As the offset from 0 mV increases the reference is becoming more contaminated. Within an offset of 1.3 pH units the electrode is still typically deemed to be good for use. Between 1.3 and 4 pH units the electrode may still be within a usable range but has deteriorated significantly. When the offset reaches 4 pH units or 240 mV the reference has been contaminated to the point where it can no longer be relied upon for use in the process.

There are two major contaminants in the industrial market, Sulfide ($S^{=}$) and Cyanide (CN^{-}). Sulfide is commonly found in Kraft Pulp and Paper mills. All of the different liquors in the Kraft process that are analyzed have a high Sulfide content and therefore, the pulp stock will have a significant amount of Sulfide as well. Cyanide, on the other hand, is typically found in mines and metal refineries. The cyanide is used as a precipitate for metal separation in flotation cells. Thus, contamination of the reference is an issue for both pH and ORP cells which are used in these processes.

To combat reference wire contamination, double junction and/or plasticized references are used to slow down the migration of the sulfide or cyanide to the reference wire. Figure 6 is a diagram of a single junction and a double junction reference for comparison purposes.

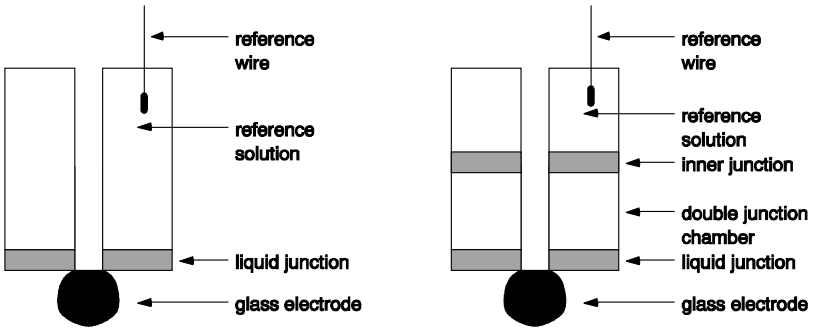


Figure 6 Double Junction Reference

The second junction is used to increase the path length of the contaminants to the reference wire. The longer the migration path, the longer it will take to reach the reference wire thus extending the life of the reference. The second junction also acts as a barrier which will slow the migrating ions, again extending reference life. The other contamination deterrent is the plasticized reference solution. The plasticized reference is effective because it impedes ion

migration through a solid as opposed to a liquid. The more solid the reference solution the longer it will take thus protecting the Silver\Silver Chloride wire.

For applications that contain Sulfide or Cyanide, a double junction plasticized reference will extend the life of the pH or ORP probe.

Chemical Compatibility with Glass

In an industrial pH steam there are usually a number of different chemicals present, some of which may not be compatible with pH glass. One of these chemicals has already been mentioned in the Caustic Ion Error section which specifically addresses the problem of Hydroxide etching of the glass which will cause sluggish response.

Another chemical that causes problems is Hydrofluoric acid, which will eventually etch the glass membrane away so there is no sensing glass left. To help with longevity of the electrode, thicker glasses are used so that it will take longer to erode the sensing membrane. Be careful of the relationship between temperature and resistance of the glass. The thicker the glass the higher the resistance. Although a thicker glass is better for HF applications, the normal operating temperature of the process must be taken into consideration, as is mentioned in the Temperature Effect on Glass section, so that a compromise between longevity of the probe and response time is established. Tests of various glasses have shown that certain glasses resist F^- attack better and are applied for these applications.

Another chemical that should be taken into consideration is Ferric Chloride which is used in Sewage systems as a complexing agent. Ferric Chloride will attack the glass electrode at the active pH sensing sites, rendering those sites inactive. Inactive pH sensing sites on the glass will result in sluggish response to pH changes in the process. To contend with this problem, put the electrode in "Electrode Renew Solution" on a regular basis, to skim off a micro-layer of bad inactive glass leaving behind a fresh layer of glass for better pH response.

Sand Blasting Due to Slurry

In mining applications there is normally a lot of grit which is traveling at a high velocity. When this grit hits the glass sensing electrode it has a "sand blasting" effect causing the glass to become pitted. This decreases the response of the electrode and wears the glass away. To help keep the glass intact the probe should be turned so the flutes are at 75^o to the flow (as in the glass coating situation - See diagram). By inserting the probe at this angle a vortex will be created around the glass. The vortex will increase the velocity of the process around the glass and reference separating the grit by centrifugal force, which will also quicken the electrode response time and keep the reference cleaner by using the abrasive nature of the slurry. By turning the flutes to 75^o the process does not directly hit the glass. Keeping the glass out of the path of the sandblasting slurry which will lengthen electrode life.

Clogging of Electrode Tip

One of the major concerns in Pulp applications is clogging of the electrode tip. Pulp fibers get caught in the area around the glass, clogging the electrode. The reference and glass no longer have contact with the process and thus, proper pH measurements cannot be taken. There are two different electrode modifications to help alleviate the clogging problem including the use of a flat glass style of electrode. With flat glass the surface of the glass is parallel to the flow therefore, as seen below, the glass does not come in contact with solution as well as a dome type of glass. The best proven way to design the probe is to use domed glass in with a body configuration that will not clog, while at the same time protecting the tip to the shearing action of dense pulp stock. To accommodate all of these, a pulp modified tip, shown below, was developed to ensure better contact with

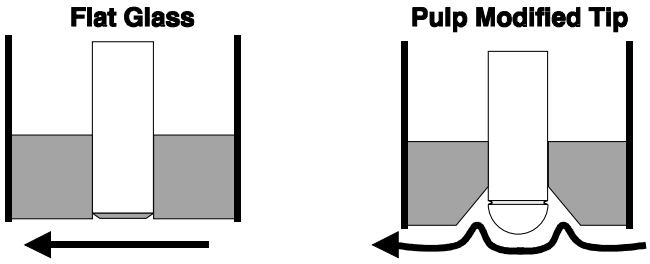


Figure 7 Flat and Pulp Modified pH Glass

solution while protecting the tip from the shearing action of the stock and clogging.

High Purity pH

Due to the lack of conductive ions in high purity water a number of interference's occur which show up as a drifting and spiked measurement often far from the correct value. Without ions providing a conductive short circuit the pH electrode, coupled to a modern ultra high impedance preamp, acts as a high gain, high efficiency antenna. Escaping chloride ions from the reference cell tend to partly short the high resistance allowing the pH electrode to establish a pH output. When changes in sample flow occur, the

rate at which ions are swept away is upset causing a compensating adjustment in the pH electrode. This effect is often described as sweeping away of the “ion cloud.” A related effect is the junction potential at the reference junction which is also affected by the number of ions and the rate of sweeping away. As sample flow increases the actual conductivity produced by the ions drops due to fewer ions left in the area of the junction. The junction, like a thermocouple, puts out a millivoltage relative to the two dissimilar conductors it is composed of. This, of course, changes if one of the conductors is changing.

A high purity pH electrode takes into account all of these effects. A stainless steel flow cell is used for shielding together with a total surround shield. Ion scarcity is compensated for by driving the cell with the analyzer power to produce an electron rich environment. Sample flow is reduced to a low, constant figure and the reference junction is modified to provide a more gradual change in the conductivity level and thereby increase potential stability. A large reservoir of KCl is supplied to provide the necessary ions and also isolate the normal AgCl component from the high purity water. Otherwise silver with low solubility precipitates out to plug the junction and cause premature failure. See the 615 pH sensor and articles in the boiler water section for more on pH measurement in low conductivity water.

Sluggish Response

When looking at the performance of an electrode one of the criteria is the speed of response. Thus, when the electrode is slow to respond to pH changes in the system, it is a concern. Therefore, it is important to address some of the different factors that can cause sluggish electrode performance.

Several different causes that effect electrode performance have already been discussed in the this article; the Coating of the Glass, Sand Blasting Due to Slurry, Caustic Ion Error, and the factors affecting the resistance of the glass. Yet, besides simple “old age”, there is one other reason for sluggish response that is important.

Sluggish response is likely to occur when an electrode is taken out of storage due to hydrolysis of the electrode membrane. The electrode is stored in salt water when shipped, which is not Hydrogen ion rich as is best suited for the glass. To revive the electrode immerse it in a beaker of 4 buffer until the reading gets relatively close to pH 4. Rinse off the electrode and place it in pH 7 buffer until the reading gets relatively close to pH 7. Keep alternating between 4 and 7 buffer until the response time is normal.

Comparison with Lab Results

When analyzing the pH of the process a common step in ensuring accuracy is to have the lab do a grab sample analysis. Difficulty can occur when the lab results do not correspond to the process analyzer, which is surprisingly common due to discrepancy between lab and process sample conditions.

A common lab analysis procedure is as follows: A grab sample is taken to the lab in an open container within 10 to 15 minutes and placed on the lab bench. The bench meter is calibrated within 5 minutes and a non temperature compensated pH reading is taken of the process sample. This grab sample procedure has a high potential for discrepancy between the two sample conditions.

First, the time between sample being taken and the lab pH measurement was approximately 20 minutes. In this time the sample will cool down, the solution chemistry will change and thus, the pH reading at the cooler temperature will not be indicative of the pH at sample conditions. A good indicator that solution temperature affects pH is buffer solutions, which have temperature curves associated with them. Buffers are specifically designed to resist pH change.

A second problem relates to temperature compensation of the lab analyzer. As seen in the Heat Effect on Slope section, it is very important to have correct temperature compensation to ensure that accurate pH reading are reported.

A third point relates to contamination. The lab sample was in an open beaker and was walked through an industrial plant with contaminants in the air. As the open beaker is carried through the plant it will likely pick up some of these airborne contaminants which could alter the pH of the sample.

Therefore, when noting the difference between a grab sample pH and the process pH, it is important to make sure that the grab sample measurement is done at the same sample conditions as the process to make sure the two readings are comparable. In fact, because the process pH electrode does not get exposed to these potential sources of error it may well be more accurate than a grab sample.

INSTALLATION

Selecting the Location

For the pH sensor to work reliably, the installation location must ensure that the pH electrode is always completely immersed in liquid. To respond well the sensor must be positioned in some flow where it sees the change in pH (e.g.. after the leak point). Long sample lines should be avoided wherever the pH signal must be responsive to sudden changes, to avoid sample transport lag problems. Care must be taken to ensure any bubbles entrained in the liquid will not pass through the pH sensing tip as the void they create in the measuring circuit will reduce the ion connection and produce erroneous results. Similarly, solids or sludge should be taken into account that may coat the electrodes, position the sensor to pick-up only the cleanest possible sample. The installation should also provide for easy sensor calibration, with sensor removal room and 1 meter (3 feet) or so of flex-conduit for calibration.

Analyzer Location

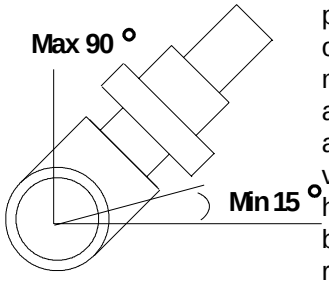
The sensor is typically supplied with at least a 1.5 meter or 5 foot lead (642 has 3M or 10Ft) as standard. The analyzer should be kept within the sensor lead length, and mounted typically on a wall at eye height. Position the analyzer to allow the sensor, still connected, to be removed and the electrode tip placed in a beaker on the floor for cleaning or calibration. Assume the safest place for the beaker is on the floor the service person stands on. Horizontal separation between rows of analyzers should allow for electrode leads which need periodic replacement, and the electrical conduit. IC CONTROLS recommends 10cm (4 in) minimum separation between rows / columns.

Pipe mounting kits, IC CONTROLS analyzer option-8 for 5cm (2in) pipe, P/N A2500255 are also available. They may also be used to surface mount the transmitter by removing the 2" U bolts and using the holes in the mounting plate for wall studs (*using customer-supplied studs*). The mounting plate dimensions are 20.3cm x21.6cm (8"x8.5") with elongated U bolt holes.

Panel mounting kits, IC CONTROLS analyzer option-9, P/N A2500201 are also available. They requires a customer supplied panel cut-out.

pH Sensor Mounting

It is recommended that the pH sensor be located as near as possible to the pH transmitter, to minimize any effects of ambient electrical noise interference.



Sensor Angle

pH sensors can be in any orientation but should be mounted tip down at an angle anywhere from 15° above horizontal to vertical, 15° above horizontal is best because air bubbles will rise to the top and grit will sink, both bypassing the sensor.

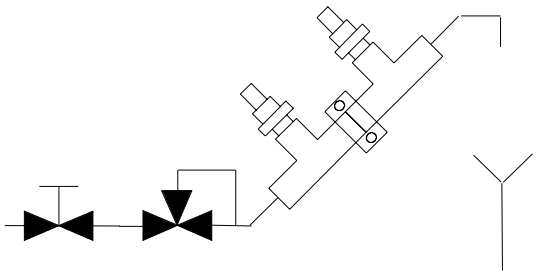
Submersion sensors should not be mounted where a lot of air bubbles rise in the tank; they will cause spikes in your pH readout. If a bubble is allowed to lodge in the sensing tip, electrical continuity between the electrodes may be disrupted.

FLOW MOUNTING

Flow type installations available are;

1. CPVC flow housing with 1.5" FNPT connections (for use with 625 Quick Union Sensors).
   In CPVC P/N A2300073
   In PVDF P/N A2300074
   In 316 SS P/N A2300075
2. Sch. 80 pipe tee with 3/4" connections (offers economy and general utility with 602 sensors).
3. 316 SS flow housing for 6.5" 605 SS pH sensor, used on condensates and clean waters where a SS sample system is desired P/N A3100071
4. 316 SS flow housing for 615 High Purity pH sensor used on pure applications (option -21 for 615) P/N A2100059.

Install the housing at 45 degrees or vertically and position the sensor so that the tip is below the outlet. This will ensure the sensor is in sample at all times, even if the exit pipe drains to atmosphere and air can enter. Flow should be upwards and out the side, thereby flushing any bubbles out of the cell area.

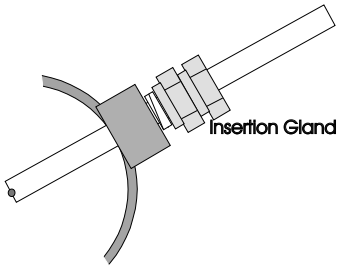

Recommended Piping

The housings can be used as an in-line body or in a side stream line. Always place on the pressurized side of a pump, not the suction side, and if using as an in-line arrangement allow for the added flow resistance caused by the sensor body.

INSERTION MOUNTINGS

If the vessel will be full at all times when the pH needs to be measured, the sensors can be inserted into a threaded opening. The location must ensure the sensor is at 15° above horizontal, fully submerged and not subject to blanketing with deposits. Removal clearance is necessary with any insertion sensor and usually 12" is sufficient.

DIRECT INSERTION INSTALLATION
INTO TANKS or PIPES



Warning:
The major consideration for insertion mounting is that a hole exists in the vessel/pipe wall if the sensor is removed for calibration, etc. Insertion sensors are often called "Hot Tap" because a solid stream of hot process liquid will escape it the sensor is removed, unless the pressure and level are lowered below the hole.

Insertion type installations available are;

1. Economical pH sensor "threaded in" insertion with 3/4 inch MNPT on tip of 602 (opt -19), or 1 inch MNPT on tip of 642 (opt -21[x]).

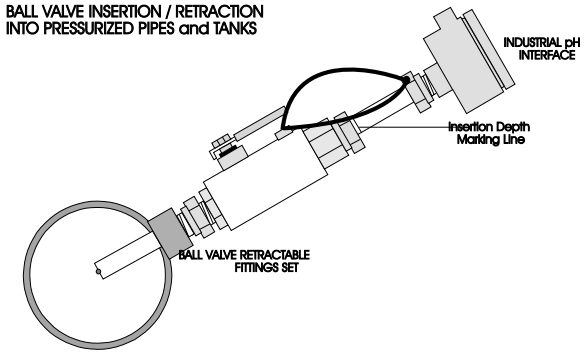
2. 3/4 " NPT SS Gland fitting insertion for use with 605, (option -74) P/N A3100002. In Titanium (option -75) P/N A3100003. In Hasteloy C (option -76) P/N A3100212.

3. 1 inch NPT SS Gland fitting insertion for use with 607, (option -74) P/N A3100175. In Titanium (option -75) P/N A3100095.

4. 1-1/2 inch NPT CPVC Gland fitting insertion for use with 643, (option -21) P/N A3600013

5. Quick Union insertion fitting with 1.5" MNPT connections for 625 pH sensors. In;
CPVC P/N A2300086, 60 psi at 90°C(194°F)
PVDF P/N A2300087, 90 psi at 90°C(194°F)
316 SS P/N A2300088, 90 psi at 90°C(194°F)

BALL VALVE RETRACTABLE MOUNTINGS



The IC CONTROLS Model 606, 617 and 643 ball valve insertion / retractable sensors were developed to handle the problem when the pressure / level cannot be lowered below the hole; similar ball valve options are available on 605 and 607. When used, the benefits and economy of no sampling system are available, even where the process must stay pressurized or draining the system would be costly.

Removal clearance is necessary. With the 606, 617 retractable sensors and the 605 and 607 retraction options, 30" clearance is needed, the sensor normally extends about 18" from the mounting opening. With the 643 36" clearance is needed.

Ball Valve insertion assemblies require a weldlet mounted on an angle of 15° or greater above horizontal to keep air bubbles out of the pH tip.

Ball valve Insertion / Retractable installations available are:

1. 1-1/2 inch NPT, CPVC Ball Valve Insertion / Retractable assembly, for 643 "Survivor" pH sensor option -74.

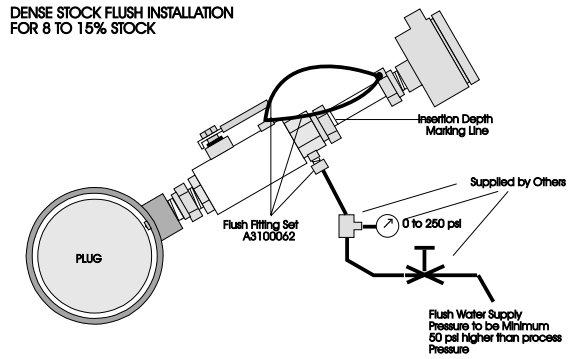
2. 1 inch NPT, SS Ball Valve Insertion / Retractable assembly, for 606 "Safety, anti blowout lip" pH sensor (option -21) P/N A2100071.

3. 1-1/4 inch NPT, SS High Pressure Ball Valve Insertion / Retractable assembly, for 617 "Isolation chamber" pH sensor. Chamber retains flashing process liquid.

4. 1 inch NPT, Ball Valve Insertion / Retractable assembly, for 605 pH sensor, in SS (opt -21) P/N A2100052, in Titanium (opt -23) P/N A2100055, in PVDF (opt -26) P/N A2100054, or in Hasteloy C (opt -27) P/N A2100056.

5. 1-1/2 inch NPT, Ball Valve Insertion / Retractable assembly, for 607 pH sensor, in SS (opt -21) P/N A2100253, or in Titanium (opt -23) P/N A2100209.

PULP & PAPER STOCK MOUNTINGS



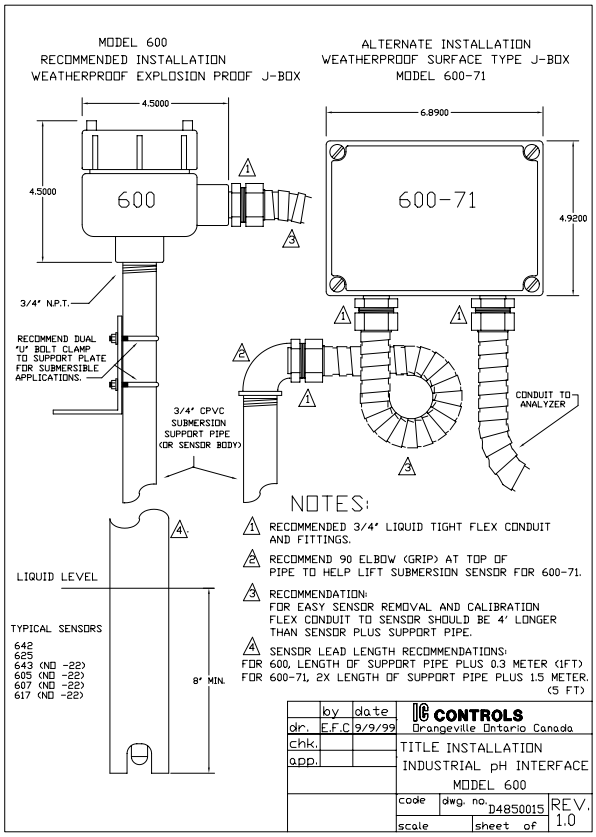
IC CONTROLS Model 606, 605 Ball Valve insertion / retractable sensors have optional fitting sets with water injection ports for use on dense pulp stock applications. Purging the insertion opening with pressurized water, pushes out dewatered stock that has plugged the opening, before the pH sensor is inserted. Model 617 handles the problem even with high pressure, up to 300 PSIG.

1. *For 606 "Safety, anti blowout lip" pH sensor, 1inch NPT, Dense Stock flush fitting set;* in SS (option -24) P/N A3100241, [in Titanium (option -25) P/N A3100242],[in Hasteloy C (option -28) P/N A3100243], plus Ball Valve Insertion / Retractable assembly, in SS (option -21) P/N A2100071, [in Titanium (option -23) P/N A2100072], [in PVDF (option -26) P/N A2100073], [in Hasteloy C (option -27) P/N A2100074].

2. *For 605 pH sensor, 1 inch NPT, Dense Stock flush fitting set;* in SS (opt -24) P/N A3100062, in Titanium (opt -25) P/N A3100126, or in Hasteloy C (opt -28) P/N A3100228, plus Ball Valve Insertion / Retractable assembly, in SS (opt -21) P/N A2100052, in Titanium (opt -23) P/N A2100055, in PVDF (opt -26) P/N A2100054, or in Hasteloy C (opt -27) P/N A2100056.

SUBMERSION MOUNTINGS

All IC Controls submersion pH sensors have the electrodes sealed in epoxy, to stop liquid leaking into the internals and shorting problems, plus provision for an "Industrial pH Interface" mounted on top of the sensor support pipe (see drawing D4850015). The 600 Industrial pH Interface makes a convenient point to disconnect the pH sensor for inspection, cleaning or other service, plus it strengthens the week pH signal so it can go thousands of feet (max. 100ft without interface). Alternative arrangements use a 600-71 surface mounted pH Interface, or a direct connected pH analyzer or transmitter within 3 meters (10 feet).



Locate where there is sufficient flow or agitation to ensure a representative sample reaches the pH sensor, stagnant spots such as corners should be avoided. Sensors with flutes around the pH glass electrode are preferred for submersion service; in services where abrasive grit or gravel is entrained in the liquid flat pH glass to may achieve further resistance to impact. Note: Flat pH glass is not as good on hot or cold applications since the thermal expansion causes a shearing action, that wants to "pop-off" the tip. Whereas standard round pH glass tends to absorb thermal expansion stresses.

HEAVY INDUSTRY 642

For Industrial sewers, mine floatation cells, tanks and other dirty applications, the 642 pH sensor presents an easy to clean solution with clearance for screwdriver cleaning around the pH glass. Its flutes also provide protection from impact on the bottom or from floating debris. This INDUSTRIAL pH sensor is BIG and RUGGED, built in a heavy Schedule 80 pipe it's "one of the world's most rugged pH electrodes". It's cushion mounted glass pH electrode survives and has even given years of reliable service after being driven over by a heavy truck!

Submersion can be 3 meters (9 ft), or more, with 642 sensors, standard lead length is 10 ft, however longer leads can be special ordered. They should be mounted preferably on a 3/4" NPT thread on the end of a 3/4" SS pipe for best rigidity, or Sch. 80 PVC pipe where whipping due to flow resistance will not present a problem.

IC CONTROLS recommends mounting a 600 pH interface and J-box on top of the pH sensor support pipe. For ease of calibration, allow pipe length plus 1 meter (3-4') extra of flex-conduit, and where possible install the support pipe on a railing with easy access for quick disconnect.

LIGHT INDUSTRY 602

For cleaner light industrial applications and effluent streams, the 602 pH sensor can be used. It's flutes also provide protection from impact on the bottom or from debris. This LIGHT INDUSTRIAL pH sensor is RUGGED, built in a lighter Schedule 80 pipe it's "The Survivor". It's shock mounted glass pH electrode can give years of reliable service, but its not a 642, it wont work after being driven over by a heavy truck!

Submersion can be 1 meter (3 ft), or more, with 602 sensors, standard lead length is 5 ft, however longer leads can be special ordered. They should be mounted preferably on a 3/4" FNPT thread on the end of a 1" Sch. 80 PVC support pipe.

STRONG SS INDUSTRIAL 605 (or 607)

For demanding industrial applications where you must have stainless steel, the 605 (or 607) pH sensors can be used. It's flutes also provide protection from impact on the bottom or from debris. This INDUSTRIAL pH sensor is STRONG, built in a 316 SS tube it handles rough applications where plastics do not survive. It's shock mounted glass pH electrode can give years of reliable service, and its small diameter better resists the bending forces of fast flow and entrained materials.

605 submersion can be 1 meter (3 ft), or more, with standard lead length of 5 ft, however longer leads can be special ordered for greater depths. Mount preferably on a 3/4" FNPT thread on the end of a 1" Sch. 80 SS pipe, using the supplied P/N A310000 fitting. The 607 mounts similarly on a 1" FNPT thread on the end of a 1 1/4" Sch. 80 SS pipe, using a P/N A3100175 stainless steel insertion gland fitting, (607 option -74).

Sensor Wiring

pH IS A VERY TINY SIGNAL

History has shown that pH electrode signals can easily be disturbed because the glass pH electrode puts out a very tiny signal. IC CONTROLS highly recommends the use of an "Industrial pH Interface" that strengthens the signal so it has a reasonable chance of remaining stable in a plant environment. pH electrodes have a very high impedance which makes their leads a good antenna that easily picks up electrical noise in a plant. Long leads are long antennas and often result in unstable pH readings. A 600 Industrial pH Interface gets rid of the problem and connections can be extended to thousands of feet.

NEVER CUT AND SPLICE pH LEADS

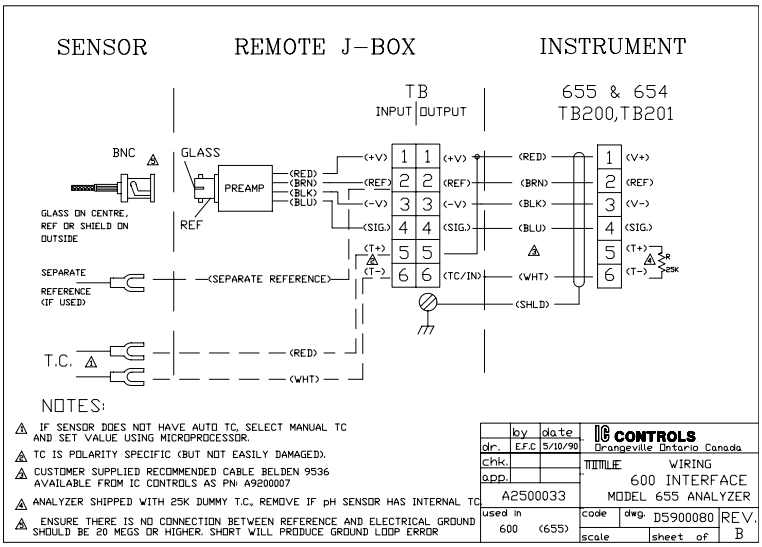
All pH sensors are supplied with a high impedance connector, often a BNC, which is designed to ensure that fingerprints, dust, and moisture do not drain away the almost none detectable pH signal. It is very very difficult to make a field splice without leaving any fingerprints or deposits that normal humidity on a dry day can turn into a signal drain and presto no pH! The only splice method known to work reliably for pH is to use a pH extension cable, or an Industrial pH Interface.

600 INDUSTRIAL pH INTERFACE

pH EXTENSION CABLES

Length	Part Number	with TC leads
46cm (18 in)	A2000615	A2000615-21
1.5 m (5 ft)	A2000617	A2000617-21
3 m (10ft)	A2000618	A2000618-21
4.5m (15ft)	A2000619	A2000619-21
6 m (20ft)	A2000620	A2000620-21
9 m (25ft)	A2000621	A2000621-21
by special order, (XX) equals length M or F		
over 10 m	A2000622(XXM)	A2000622-21

The basic wiring scheme for all IC CONTROLS pH sensors is shown in drawing D5900080, plus wiring of the 600 industrial pH interface to the analyzer.



This wiring scheme is intended for cable runs up to 1000 meters (3000 feet). The cable is available from IC CONTROLS as A9200006, or often locally as Belden 9535.

Take care to route all sensor wiring away from AC power lines, to minimize unwanted electrical interference. When installing pH sensor cable in conduit, use caution to avoid scraping or cutting the cable insulation, the resulting short of the cable's internal shield will cause pH ground loop errors. As well, avoid twisting the sensor lead, to minimize possibilities for broken wire.

DIRECT CONNECTED pH

In areas where electrical interference is not high, direct connection from pH sensor to a pH analyzer with option -6 integral high impedance input can be used for distances less than 30 meters (100 feet).

IC CONTROLS pH sensors are supplied with three leads. The Black Coax lead with BNC connector is always connected to the sensor pH electrodes. The center lead and shield (outer) lead of the coax should be insulated from each other as well as from the red and white temperature compensator leads, plus insulation to ground for all leads. T.C. leads are polarity specific using -33 IC Controls TC (but not easily damaged), red is TC positive and white is TC Negative.

Instrument Shop Tests

CHECKING THE SENSOR

The sensor should be checked against the ordered specification to ensure the correct sensor for the job is used. Refer to Specification Sheets, Sensor Selection Guide, to confirm the model number received. Electrical checks may be made to ensure the sensor is in good condition before installation. Between the BNC center and outer housing pH glass resistance should exceed 20 meg ohms. Between the red and white temperature compensator leads there is either a semi-conductor (opt -33) which un-powered appears open circuit, or an RTD, the resistance value given for the T.C. at 25°C is (opt -31) 3000 ohms, (opt -32) 110 ohms, (opt -34) 1096 ohms. Between either T.C. lead and either cell lead there should be insulation values exceeding 20 meg ohms.

Preparation for use

1. Moisten the sensor body with tap water to remove any salt deposits, then remove the lower (storage) plastic cap. Rinse the exposed pH electrodes with tap water, making sure all salt crystals and/or other deposits are gone.

2. First time use, or after long term storage, immerse the lower end of the sensor in a 4 pH buffer for 30 minutes. This conditions the pH glass electrode and prepares it for stable readings in other buffer solutions.

Note: 1 IC CONTROLS pH sensors are shipped packed in pH electrode storage solution. Storage solution extends the life of the reference pH electrode which after long storage might give short service life; however when first unpacked the pH response may be slow,.

Note: 2 For new pH sensors we recommend a soak in 4 buffer plus calibration with 7 buffer and 10 or 4 buffer, depending on the normal application pH, to achieve good accuracy. If during buffering the pH sensor seems slow, cycle a few times from 4 to 10 buffer to “wake-up” the pH glass response, it should speed up noticeably.

Note: 3 Packed in storage solution, pH electrodes are often ready for use immediately with typical accuracy of ±0.2 pH without calibration.

Testing with the Analyzer

Refer to your analyzers instruction manual for proper wiring instructions unique to it.

1. Apply power to the analyzer.
2. Hook up your sensor, and remove the orange protective cap.
3. Sensor in 7.0 buffer the pH Analyzer should come up reading 7.0 ±0.5 pH
4. Run a “zero” calibration (7 pH is electronic 0.0 mV) so use 7 buffer, if possible, use the pH extension wires to be field installed and allow 30 minutes warm-up time for the electronics to stabilize.
5. Run a “span.” calibration, place the Sensor in 4.0 buffer. The display should read approximately 4.01 ±0.05 pH
6. To check for general performance place the pH Sensor in 7.0 buffer again. It should now read approximately 7.0 ±0.05 pH.
7. The pH sensor is now ready for field installation.
8. If the application will be in the caustic region repeat steps 5 and 6 using 10.0 buffer, so the electrode was tested in the region of use.

pH BUFFERS

COLOR-CODED STANDARD BUFFERS

IC CONTROLS Laboratory Certified ±0.02 pH versus NIST Traceable Buffers

Buffer	Color	Part No.	Size	6-pack
Mixed	R/G/B	A1100054	(2) A1100051, (2) A1100052 and (2) A1100053	
4.00 pH	Red	A1100051	500 mL	A1100051-6P (6x500 mL)
7.00 pH	Green	A1100052	500 mL	A1100052-6P (6x500 mL)
10.00 pH	Blue	A1100053	500 mL	A1100053-6P (6x500 mL)
Deionized Water	Clear	A1100192	500 mL	A1100192-6P (6x500 mL)

NIST TRACEABLE BUFFERS

(prepared by ASTM Method)

P recision IC CONTROLS Laboratory Certified ±0.01 pH versus NIST Certified Reference Materials (SRM)

	Buffer	Color	Part number	Size	6-pack
	10.01 pH	Clear	A1100017	500 mL	A1100017-6P
	7.00 pH	Clear	A1100018	500 mL	A1100018-6P
	4.00 pH	Clear	A1100019	500 mL	A1100019-6P
Primary	4.008 pH	Clear	A1100023	500 mL	
Std. Buffers	6.863 pH	Clear	A1100026	500 mL	
	7.415 pH	Clear	A1100027	500 mL	
	9.180 pH	Clear	A1100029	500 mL	
	10.011 pH	Clear	A1100031	500 mL	
Secondary	1.679 pH	Clear	A1100022	500 mL	
Std. Buffers	12.454 pH	Clear	A1100030	500 mL	

pH Trace Certificate, P/N A1900334, records full calibration trail to NIST SRM and their lot numbers

Also available, pH Standards 1.00, 2.00, 3.00, 4.00, 5.00, 6.00, 7.00, 8.00, 9.00, 10.00, 11.00, 12.00 and 13.00 pH

Non-NIST pH standards available with pH values from 1.00 to 13.00. They have less buffering capacity (resistance to pH change) than NIST and ASTM method buffers. However, they still can provide single use checkpoints close to the important process endpoint.

About Calibration . . .

When you buy from IC CONTROLS our commitment to you includes the standards to properly clean and calibrate the equipment. Our commitment to you does not stop when we ship the equipment, it continues until you have calibrated the analyzer system, are satisfied with the results and beyond. To assist you in obtaining reliable results, IC CONTROLS developed calibration and cleaning procedures and manufactures and packages the necessary standards, buffers and supplies in convenient usage quantities. If you need assistance with calibration techniques or any other matter, our application development laboratory specialists are only a toll-free phone call away for advice and/or laboratory simulation of your problem.. Buy from IC CONTROLS because you get outstanding customer support as well as quality industrial equipment; in short, REAL SOLUTIONS.

pH CALIBRATION KIT

P/N A1600050

This kit conveniently packages the requirement for buffer calibrations in amounts for easy use, along with the necessary utensils and accessories. These items are provided in durable plastic. This way, you are assured reliable and accurate results, and at the same time the technician's job is easier.

This kit is a one-year supply of all maintenance items and includes one each of the following:

Description	Color	Part No.	Size
4.00 pH Buffer,	Red	A1100051-6P	6 x 500 mL
7.00 pH Buffer,	Green	A1100052-6P	6 x 500 mL
10.00 pH Buffer,	Blue	A1100053-6P	6 x 500 mL
Electrode Wash Solution,	Clear	A1100091	1 x 500 mL
Beakers,		A1100020 (x4)	4 x 250 mL
Squeeze Bottle,		A1100014	1 x 120 mL
Deionized Water	Clear	A1100192-6P	6 x 500 mL

About Calibration . . .

When you buy from IC CONTROLS our commitment to you includes the standards to properly clean and calibrate the equipment. Our commitment to you does not stop when we ship the equipment, it continues until you have calibrated the analyzer system, are satisfied with the results and beyond. To assist you in obtaining reliable results, IC CONTROLS developed calibration and cleaning procedures and manufactures and packages the necessary standards, buffers and supplies in convenient usage quantities. If you need assistance with calibration techniques or any other matter, our application development laboratory specialists are only a toll-free phone call away for advice and/or laboratory simulation of your problem.. Buy from IC CONTROLS because you get outstanding customer support as well as quality industrial equipment; in short, REAL SOLUTIONS.

pH CALIBRATION

The pH sensor-analyzer system is usually calibrated using standard buffer solutions. Alternatively grab-sample analysis on a previously calibrated laboratory reference pH meter can be used.

pH, is proportional to temperature. The effect is predictable and repeatable according to the Nernst equation.

Overall system accuracy is maintained by calibrating the pH sensor and analyzer together in a buffer close to the expected sample pH. The pH electrode efficiency and offset (or standardize) will change over time as the pH glass ages, deposits form, and the process affects the electrode surface.

Selecting a pH Buffer

pH buffers provide the simplest and most accurate method of calibrating the pH sensor and analyzer.

First Buffer: The first step is to use pH 7 buffer to calculate the mV offset of the electrode from the theoretically perfect 0 mV. pH 7 buffer is used because it simulates 0 mV thus making it the best standard because the electronics is also at this 0 mV reference point.

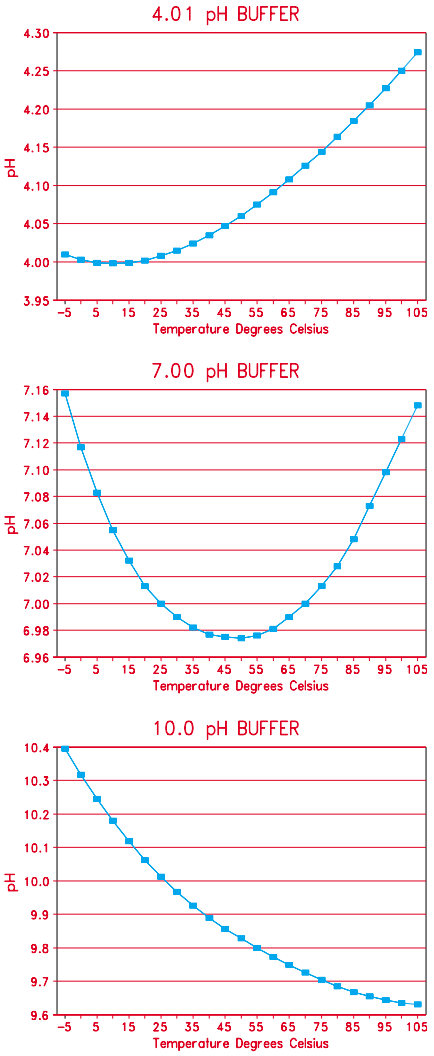
Second Buffer: The next step in the calibration is to use a second buffer (usually 4 or 10). When choosing which buffers to use in calibration it is best to choose buffers that fall on both sides of the normal operating pH. By using these two buffers the slope calculation will encompass the normal pH, thus giving the most accurate pH measurement. Either of these buffers gives a large enough space relative to the pH 7 buffer that a good slope can be calculated. When performing the two point calibration a percent value will be given in microprocessor based pH analyzers. The closer to 100% the slope is the better the efficiency and thus the performance of the electrode.

Some analyzers such as IC CONTROLS 655 have been programmed to recognize the three buffers most commonly used for calibration: 4, 7, and 10 pH. To achieve greater accuracy, the temperature compensated values for the 4, 7, and 10 pH buffers are calculated by the analyzer. Simply place the electrodes in the buffer solution and the analyzer will use the correct buffer, allowing for an offset of up to ± 1.3 pH units.

Temperature Dependence of Buffers

The pH of a solution is dependent on temperature. To achieve greater accuracy, the temperature-compensated values for the 4, 7, and 10 pH buffers are calculated by IC CONTROLS analyzers.

The graphs show the temperature-dependence of the standard buffers. The tc-curves have been programmed into IC CONTROLS analyzers. The actual pH value of each of the three standard buffers will be used.



Example: Calibrate with the 4.01(at 25°C) pH buffer. The temperature of the buffer is 50°C. The analyzer will use the pH value of 4.05.

Incorrect Buffer Selection by the Analyzer

If the offset is known to be greater than ±77mV or if the analyzer selected the wrong buffer using automatic buffer recognition, then it is necessary to specify which buffer is being used. This is done by selecting [4.01], [7.00], or [10.0] then an offset of ± 4 pH units is allowed and temperature-compensated values are still used.

Other Buffer Values or Custom Buffers

If a buffer with a pH value other than 4, 7, or 10 pH is to be used, select [cuSt] (custom value), then enter a value between 0 and 14 pH. Buffer values entered this way are not temperature-compensated; the buffer is assumed to have the specified pH value at the current temperature. Offsets of up to ± 4 pH units are allowed.

Electrode Life

The electrodes need to be calibrated periodically to maintain accurate pH measurement. IC CONTROLS recommends electrodes be calibrated every 30 days. Depending on the process, they may need to be calibrated more frequently, e.g. weekly or even daily. More frequent calibration is important if high accuracy pH measurement is required.

Over time electrode performance will degrade. The pH glass becomes less responsive to pH and the reference electrode becomes depleted. Expect the electrodes will need to be replaced after several years of use, or sooner depending on the harshness of the process.

*If using **IC CONTROLS pH ANALYZER** they have 4-20 output hold during calibration, storing the last measured pH in memory, also alarms do not sound. As well a 15 minute timer ensures return to sample after a calibration.*

Standardizing — Single-Buffer Calibration

Standardizing the pH sensor causes the analyzer to calculate the ***offset*** for the pH sensor. The electrode slope value determined during the last buF2 calibration (or theoretical 100%) will be used.

NOTE: Instructions are based on an IC CONTROLS microprocessor analyzer.

1) Rinse the pH sensor in clean water such as demineralized water to remove drops of process liquid.

Although pH buffers are formulated to resist pH change, mixing in strong foreign ions can cause pH shift and resultant calibration to an incorrect pH value. Dirt deposits, biological growths, and any other contaminants should be removed from the pH sensor body and tip before calibration.

2) Select the buffer with which to calibrate. See *Selecting a Buffer* for an explanation. Place the pH sensor in the buffer solution.

3) Press [SAMPLE] to display the pH reading. Press **SELECT→** to see the main menu, then the up arrow key to display [pH].

4) Press **SELECT→** again, then use the up arrow key to display [Cal]. Repeat to get [buF-1].

5) Press **SELECT→** again to reach the next menu. Use either automatic detection, a custom value, or one of the standard buffers (4, 7, 10).

6) With the electrode in the buffer solution press **SELECT→** again to start the calibration process. The display will show a flashing pH reading to indicate that the analyzer is reading pH in calibration mode and is waiting for the pH to stabilize.

As soon as the electrode has stabilized, the display will stop flashing, the electrode offset will be calculated, and the new offset (standardize) will be entered in memory.

Note: *The [ENTER] key may be pressed before the electrode has stabilized, forcing the analyzer to calibrate using the current pH input, resulting in a lower precision calibration.*

7) Confirm the single point calibration precision by repeating the calibration, steps 1 to 4. There should be close agreement between the readings and the buffer, however small adjustments may be handled by repeat calibrations.

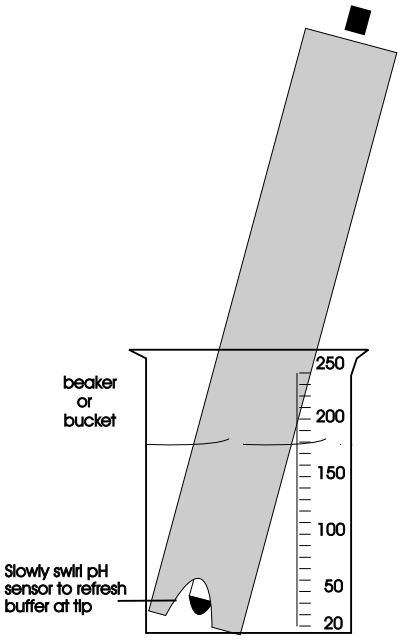
Note: *If the temperature is far from 25°C the analyzer will display the temperature compensated pH of the pH buffers. See* Selecting a Buffer *section for more information.*

Calibrations may be redone or started over at any time. Press [SAMPLE] to display the pH then **SELECT→**, as needed to restart the calibration.

If the analyzer detects a problem during calibration, a caution or error message will appear. A ***caution*** message informs the user that poor pH electrode performance is suspected and will be compensated for by the microprocessor.

If an ***error*** message is displayed, the electrodes exhibit major problems; the standardization was not successful. The analyzer will still operate, but using the values from the old calibration.

8) Press the [SAMPLE] key to resume normal operation after a caution or error message has appeared



pH CALIBRATION

The pH sensor is now standardized, and will be accurate at pH readings close to the pH of standardization.

For best accuracy over wider pH ranges finding the pH efficiency or slope using two buffers is recommended.

Discard used buffer after calibration. Used buffer usually picked up carry over buffer, contaminants, or bio-growths that cause pH error if re-used.

Calibrating — Two-Buffer Calibration

Fully Calibrating the pH sensor involves calculating both the offset and the ***pH electrode efficiency or slope*** to match a particular electrode pair. The electrode slope will be calculated as a percentage of Nernstian response (59.16mV per pH unit).

1) Calibrate the offset with 7 buffer as [buF1] by following the procedure for *Standardizing - Single Buffer Calibration* above.

2) Rinse the pH sensor in clean water such as demineralized water to remove drops of 7 buffer.

Carry over of old buffer into different fresh buffer will decrease the pH difference between the buffers producing an efficiency calibration error.

3) To calibrate with the second buffer press [SAMPLE] to return to the pH display. Then press **SELECT→** to read [pH] then again as needed to reach the buffer selection menu. Press the up arrow key to display [buF2]. Press **SELECT→** to select the second buffer.

The second buffer should be at least 2 pH units higher or lower than the buffer used for the standardize procedure. For further details see Selecting a Buffer *for an explanation of the buffer selection process.*

4) Use the up arrow key to display either automatic buffer recognition, a custom value, or one of the standard buffers (4, 7, 10). Press **SELECT→** again to start the calibration process.

5) As soon as the electrode has stabilized the display will stop flashing, the electrode slope will be calculated, and the new slope (efficiency) will be entered into memory. The analyzer will adjust its pH display.

6) Confirm the efficiency calibration precision by repeating the calibration, steps 2 to 5. There should be close agreement between the readings and the buffer, however small adjustments may be handled by repeat calibrations.

Note: *If the temperature is far from 25°C the analyzer will display the temperature compensated pH of the pH buffers. See* Selecting a Buffer *section for more information.*

Calibrations may be redone or started over at any time. Press [SAMPLE] to display the pH then **SELECT→**, as needed, to restart the calibration.

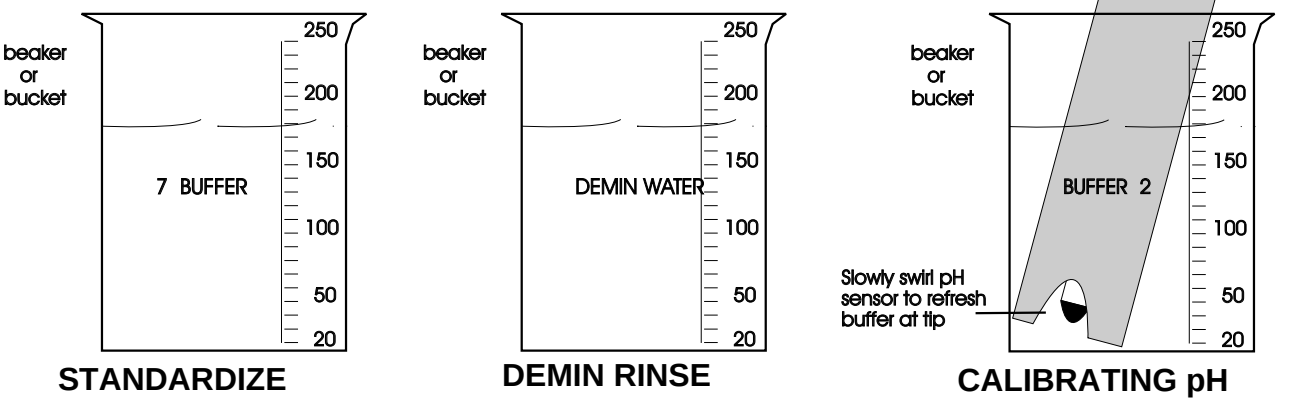
If the pH sensor exhibits a problem during calibration, a caution or an error message will appear. A ***caution*** message informs the user that poor pH electrode performance will be compensated for by the microprocessor.

If an ***error*** message is displayed, the electrodes exhibit signs of major problems, and the efficiency calibration was not successful. The analyzer will operate, but using the values from the old calibration.

7) Press the [SAMPLE] key to resume normal operation after a caution or error message has appeared

The pH sensor is now fully calibrated, and will be accurate at pH readings between the pH of the buffers used, as well as a few pH units beyond.

Discard used buffer after calibration. Used buffer usually picked up carry over buffer, contaminants, or biogrowths that cause pH error if re-used.



Grab-Sample — At Process Calibration

The grab sample method provides an easy way to calibrate the pH sensor by standardizing to the process pH, without removing the pH sensor from the process. Grab sample standardization requires the user to determine the actual pH of the process using a different method. For example, if the analyzer is reading 3.55 pH and a laboratory analysis determines the actual pH of a sample to be 3.42 pH, the grab sample method can be used to adjust the *offset* so that the previous 3.55 reading changes to 3.42 pH.

The precision of standardization using the grab sample method is only as accurate as the values supplied to the analyzer by the operator.

1) Obtain the following materials: a second high accuracy pH analyzer, a quality pH electrode and fresh pH buffers for calibrating it, and a new clean beaker or sample bottle to collect a “Grab Sample”.

2) Perform a high accuracy TWO BUFFER Calibration on your high accuracy pH analyzer, and record the date and results.

3) Extract a grab sample of the process which is representative of the solution the pH sensor is in, preferably from just beside the sensor.

4) At approximately the same time that the grab sample is taken, store the current pH in the on-line analyzer memory by selecting [PH] [CAL] [GrAb] [GEt] from the menu. Press [ENTER] at the flashing [do].

It is important that the pH value recorded in memory represents the pH of the sample. This is easy to accomplish if the analyzer has a stable reading, but difficult if there is a lot of fluctuation in the pH reading. This step can be repeated as often as necessary.

Note. It is possible to view or even change the pH value recorded in memory.
Select [pH] [CAL] [GrAb] [OLd].

5). Analyze the grab sample to determine the actual pH.

For maximum accuracy, the temperature of the sample should be the same as it was at the time the old value was recorded, using [GEt]. A significantly different pH could result if there is a temperature difference.

6). Select [PH] [CAL] [GrAb] [SEt] from the menu. Edit the pH value, using “enter” and the arrow keys, and change it to the new pH value. Then press **SELECT→** then press [ENTER] with the flashing [do] displayed. The offset will be adjusted according to the difference between the old and new pH values.

The error checking done for the grab sample calibration is similar to that done for a [buF1] standardization. An offset warning, CA1.6, is given if the new offset is greater than 1.3 pH units from theoretical behavior. If the new offset would be greater than 4.0 pH units then error 1.3 is generated and the new offset won’t be recorded..

659 Grab-Sample Calibration Tool

The Model 659 is a portable pH analyzer and a calibration instrument for pH analyzers and electrodes, all in one case. It includes a rugged combination pH electrode, that is used for grab sample pH, or to prove the accuracy of pH analyzers. The 659 and 602 pH sensor can be calibrated in 7, 4 and /or 10 buffer before going to the field analyzer site.

At site you can hook up the 602 combination pH electrode and use it as a portable calibrating pH meter, or hook up your on-line pH electrodes to the 659 to confirm their operating condition directly. The Analyzer portion can read the 602 output with 0.01 pH precision, and also can read your process pH electrodes.

The 659 also puts out an artificial pH signal based on the Nernst equation for glass pH electrode response that is universal to pH. It can be used to check the operation of, or to restore 100% Nernst calibration efficiency to any type or make of pH analyzer.

It easily isolates pH loop problems by allowing the service technician to individually prove the status of the analyzer, the wiring, the preamp, the glass pH electrode, or the reference electrode.

INSERTING / REMOVING pH SENSORS

Preparation for use

1. Moisten the pH sensor body with tap water and carefully remove the tape and (storage) plastic cap. ***Caution should be used in removing this cap; pull straight down. Do not bend the body of the pH sensor. This can result in damage to the internal element.***

Note: save this lower plastic cap for use in storage of the pH sensor.

2. Rinse away any deposits on the exposed pH bulb and junction area with tap water.

3. For the first time use, or after long term storage, immerse the pH electrode in 4 pH buffer for 30 minutes. This hydrates the pH bulb and prepares the reference junction for contact with test solutions.

4. If air bubbles are visible inside the pH bulb, shake the electrode downward to fill the bulb with solution.

5. IC CONTROLS electrodes are shipped in a pH electrode storage solution buffered to approximately 7 pH. These electrodes are often ready for use immediately with typical accuracy of ± **0.2pH** without buffering; however we recommend calibration with buffers.

6. The pH sensor is ready to place in service.

Inserting pH Sensors

Insertion Sensors should be examined for good clean sealing surfaces and installed carefully. Clean seals such as O'rings should be lubricated with silicone grease to ensure liquid tight performance.

Remove the storage cap then carefully push the sensor into the insertion fitting until it is seated against the stops. Tighten the retainer nut to hold the sensor firmly in place.

Let the vessel fill with liquid.

Your pH sensor should now read the liquid pH.

606 & 605-21 Ball Valve Sensors

Warning! The system pressure must be less than 100 PSI.

1. Inspect and clean the o'ring, gland fitting and sensor body; replace if necessary.

2. DO NOT open the ball valve. Carefully push the sensor into the ball valve until, for 605 the safety cables can be screwed into the ball valve body, or for the 606, the positive stop gland can be screwed into the ball valve bushing.

Caution! DO NOT pass this point. Damage to the glass pH tip could result.

3. Once screwed in, pull on the pH sensor to make sure it cannot come free from the ball valve.

4. Tighten the gland nut, finger tight.

5. While restraining the sensor housing by holding the junction box, slowly open the ball valve.

6. Insert the sensor until the pH tip is about where desired in the process. Measure and pre-mark if needed. This is recommended on less than 8" diameter pipe.

7a. First time installation of the sensor housing, turn the nut on the Swagelok fitting until it is finger-tight and then, using wrenches, tighten the nut 1 1/4 turns.

7b. Re-installation, turn the nut on the Swagelok fitting no more than 1/4 to 1/2 additional turn after finger tight.

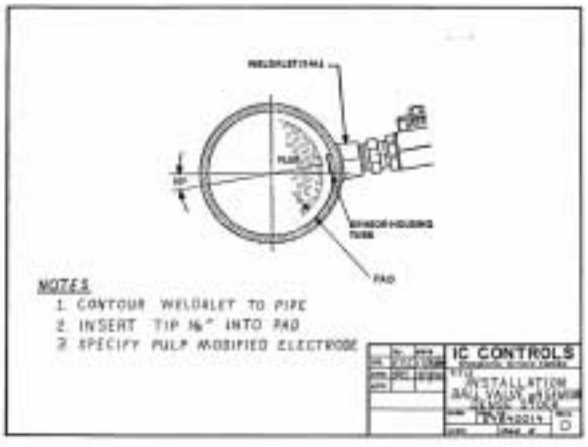
Modified Insertion - Dense Stock Applications

Caution! Great care must be taken to avoid breaking the electrodes against a stock plug which can be as solid as a wet 2 x 4.

1. Before attempting insertion, clean-out the valve and fitting assembly by hooking up a 3/4" water tube line to the 3/4" gland fitting in place of the pH sensor. Provision must also be made to permanently hook up a 3/8" water flush line with shut off valve to the side flush fitting (see illustration Page 15).

2. Open the ball valve and blast any plug out with high pressure water. Shut off the ball valve with the water pressure on.

3. Refer to Dwg. D4840014 for illustration. The objective is to place the pH tip in the liquor pad. This



can be done by using the pH sensor, however a mistake will result in a destroyed electrode. Alternately, accurate pre-measurement will give a good position for scribing the sensor body with a line for insertion depth. A second alternate uses a 3/4" diameter stainless steel rod to feel the plug. A flat holder such as the J/box and end fittings must be installed on the rod so safety cables can be hooked up to prevent a slip, allowing the rod to become a projectile. Keep the water flush flow on while probing for the stock plug.

4. Scribe the sensor body at the desired insertion point, about 5mm (1/8") back from the plug.

5. Prepare for pH sensor insertion. Check you are using the stainless steel ferrule. Inspect and clean the o'ring, gland fitting and sensor body; replace if necessary.

6. DO NOT open the ball valve. Carefully push the sensor into the ball valve until, for 605 the safety cables can be screwed into the ball valve body, or for the 606 the positive stop gland can be screwed onto the ball valve bushing.
Caution! DO NOT pass this point. Damage to the glass pH tip could result.

7. Once screwed in, pull on the pH sensor to make sure it cannot come free from the ball valve.

8. Tighten the gland nut, finger tight, then open the ball valve slowly.

9. Turn on purge water to help insert the sensor. Check you are using the stainless steel ferrule, then press sensor in only to the scribed line. Using the stainless steel ferrule, lock the sensor at this depth.

10a. First time installation of the sensor housing, turn the nut on the Swagelok fitting until it is finger-tight and then, using wrenches, tighten the nut 1 1/4 turns.

10b. Re-installation, turn the nut on the Swagelok fitting no more than 1/4 to 1/2 additional turn after finger tight.

11. Keep the water flush flow on low while measuring pH. This resists stock packing in around the sensor, however if to much water is used it will also impede pH accuracy. Some testing will determine the best setting for your application.

pH Sensor Removal

CAUTION: Use rubber gloves and appropriate face / eye protection when handling sensors coated with aggressive liquids.

Sample Line Sensor Removal

Simply turn off the sample flow and allow the sample line pressure to drop to zero, then undo the retaining nut and remove the pH sensor.

Submersion Sensor Removal

Submersion installations can typically be lifted out with the concern being liquid on the support pipe or wires.

CAUTION: Use rubber gloves and appropriate face / eye protection when handling sensors and long submersion support pipes coated with aggressive liquids.

Insertion Sensor Removal

Warning: Before pH sensor removal the process pressure must be lowered to zero, or a dangerous pressurized stream of process liquid will blast out. 602, 605, 607, and 625 sensors leave a hole in the line, vessel or tank when removed, and are intended for use only where pressure can be lowered to zero for servicing. Use of model 605, 606, 607 or 617 Ball Valve Insertion / Retractable sensors are recommended where pressure cannot be reduce to zero for service.

Vessels and tanks must be drained until the liquid level is below the sensor insertion hole for the pressure to be zero and no process liquid to escape.

Removal 606 & 605-21 BV Sensor

1. Inspect the safety cables and replace if corroded or damaged. P/N A1100011

CAUTION: On hot processes there is a risk of pressurized steam or liquid escaping. The gland has two seals to reduce this risk but scratches and grit may reduce effectiveness.

2. Release the gland nut slowly about 2 or 3 turns, allowing the pH sensor body to slide back until the stop is reached or the safety cables are tight.

3. Pull to ensure the pH sensor is fully retracted, then shut off the ball valve.

4. Only with the ball valve closed, remove the gland nut completely.

5. Then with the ball valve still closed, unscrew the positive stop gland (606) or safety cables (605) from the valve housing.

6. The pH sensor body can now be removed.

Modified Removal - Dense Stock Applications

1. Inspect the safety cables and replace if corroded or damaged. P/N A1100011

2. Open the 3/8" water flush line to clear any stock buildup in the gland, ball valve, or fitting assembly.

CAUTION: On hot stock there is a risk of pressurized steam jets or liquid escaping. The gland has two seals to reduce this risk but scratches and grit may defeat them.

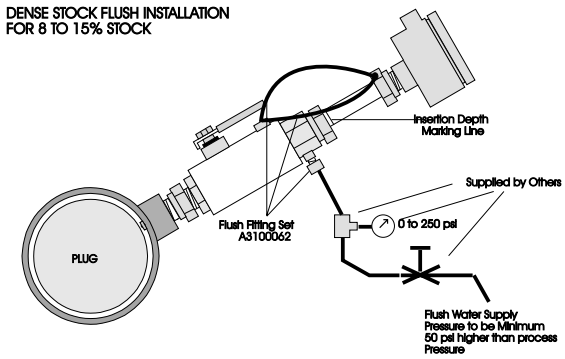
3. With flush water flowing, release the gland nut slowly about 2 or 3 turns, allowing the pH sensor body to slide back until the positive stop is reached (606) or the safety cables are tight (605).

4. Pull on the pH sensor to ensure it is fully retracted, then shut off the ball valve, and then the flush water.

5. Only with the ball valve closed and the flush water off, remove the gland nut completely releasing any pressure.

6. Then with the ball valve still closed, unscrew the positive stop gland (606) or safety cables (605) from the valve housing.

7. The pH sensor body can now be removed.



SENSOR MAINTENANCE

659 Maintenance Tool

The Model 659 is a portable pH analyzer and a calibration instrument for pH analyzers and electrodes, all in one case. It easily isolates pH loop problems by allowing the service technician to individually prove the status of the analyzer, the wiring, the preamp, the glass pH electrode, or the reference electrode.

It includes a rugged combination pH electrode, that is used for grab sample pH, or to prove the accuracy of pH analyzers.

It can calibrate any type or make of pH analyzer. The 659 puts out an artificial pH signal based on the Nernst equation (59.16mV per pH unit) for glass pH electrode response that is universal to pH.

The Analyzer portion can read the calibration output with 0.01 pH precision, and also read your process pH electrodes. Hook up a combination pH electrode and use it as a portable pH meter, or hook up your on-line pH electrodes to confirm their operating condition.

Favorite of pH service professionals:

1) 659 has a switch that flips the simulated pH electrode output for easy analyzer zero and span calibration
2) powerful signal drive to prove the operation of marginal electronics, then switch to high meg ohm impedance to test isolation integrity at pH electrode.
3) connect process electrodes to 659 analyzer and prove each one works; by substituting the “known good” 602 reference electrode, or the “known good” 602 pH glass electrode, with process electrode.
4) check the true process pH with grab sample test
5) switch it to millivolts and you now have an ORP calibrator (and/or millivolt source).

Sensor Storage

Short term: Rinse the pH sensor electrodes in demin water P/N A1100192, then store in a plastic shipping cap of 4.0 buffer P/N A1100051.

Long term: Clean the pH sensor electrodes in pH electrode wash solution P/N A1100091, rinse in demin water P/N A1100192 , then store in a plastic shipping cap of pH electrode storage solution P/N A1100090.

Monthly Maintenance

Use of a 659 portable Calibrator / Analyzer plus a A1600050 pH Calibration Kit or an A1100214 pH service pack, makes this easy. The pH service pack includes a 500ml bottle each of 4, 7, 10 buffers plus a bottle of A1100091 pH electrode wash solution, and two bottles of demin rinse water. Remove the sensor, rinse in water, remove any significant deposits, and then check by calibration in 7 for offset and then 4 or 10 buffer for slope. Alternatively, if the sensor is installed in the process and not easy to remove, follow the procedure under grab-sample calibration.

If the calibration turns up a Caution or Error message in the pH analyzer, then follow the appropriate trouble shooting procedure.

If the calibration is good, keep a log of the pH offset and efficiency at each monthly calibration.

The pH sensor is now ready to return to service.

Yearly Maintenance

Examine the condition of electrical connections in 600 junction boxes, for signs of corrosion and tight connections, replace if corroded. O’rings and teflon-sealing ferrules should be replaced on 606, 605, 607, and 625 sensors. The condition of the safety cables on 605 sensors should be examined for rust or bent mounting screws. Replace if deterioration shows.

Check the pH offset log. If the pH offset has changed more than 30 mv over the past year, it may need to be chemically cleaned — follow the *Chemical Cleaning of Sensor* procedure.

Check the pH efficiency log. If the efficiency has dropped below 90%, it may need to be chemically cleaned and restored — see *Chemical Cleaning of Sensor* and/or *Restoring Electrode Response*.

After all the above checks, plus chemical cleaning and/or restoring procedures, follow the monthly maintenance procedure. Start a new log with the improved values.

IC Net™ for Calibration Records

IC Controls Microprocessor Analyzers automatically store records of your calibrations , alarms, and upsets in their history memory. These records can be recovered using a portable PC running IC Net™. These records form a compliance

history report, which shows all changes during the last 12 calibrations.

When to clean your sensor

Various factors can affect the pH reading; scale, biological growths, oils, wax, gum, etc. all reduce the area for Hydrogen Ion to react with the glass. Biological microbe growths can also produce local pH environments inside their growth deposit, which can be quite different from the true process pH. Periodic cleaning of pH sensors will remove these deposits, restore the pH glass surface, reference junction and thus the pH accuracy.

Mechanical Cleaning of Sensor

The sensor will require cleaning if sludge, slime, or other deposits build up in the internal cavities of the sensor.

Wherever possible clean with a soft brush and detergents. General debris, oil films, bio-growths, and non-tenacious deposits can be removed in this way. The Model 642 “One of the world’s most rugged pH electrodes” has 2.5cm (1") junction diameter and open slots, chosen so a standard flat screwdriver blade can be used to scrape scale, tenacious deposits, toothpick bits, etc. off the reference junction quickly. Also, the Model 642’s open tip design allows the screwdriver to carefully score and crack hard scale against the glass shaft then carefully slide it up and off the pH glass tip without touching the pH glass, which would damage it.

For flat-surface sensors use a soft flat brush and a beaker or bucket of water with a good liquid detergent. Take care not to scratch the pH electrode glass surface, it is thin, fragile and easily broken.

All the wetted surfaces of plastic body sensors should be washed with a soft cloth. This will return their appearance to like-new condition and removes sites for buildups to occur.

When to Chemical Clean

After mechanical cleaning, as above, check the sensor against a pH buffer. If the sensor is still not developing the pH reading properly in the pH buffer, proceed to the Chemical Cleaning procedure, otherwise return the sensor to the process.

Chemical Cleaning of Sensor

A1600054 Instruction Sheet

The 1600054 is a pH Sensor Chemical Cleaning Kit of solutions and necessary items.

It contains the following:

Cleaning	2x 500ml pH Wash soln.
Cleaning	2x 500ml Gentle Scale Remover.
Final Rinse	1x 500ml Demin
Beakers	2x 250ml plastic
Gloves	1x pair Rubber Gloves
Syringe:	to provide a liquid stream
Brush:	1x Sensor cleaning

Instructions for A1600054 pH Chemical Cleaning Kit

NOTE 1: *A suitable place to do chemical cleaning is at a counter or bench with a Laboratory sink, with a chemical drain where waste is contained and treated before release.*

Note 2: *IC CONTROLS kits are kept small and portable so that they can be taken to installation sites, together with a plastic bucket of water (for rinsing) and a rag/towel (for wiping or drying). Waste materials (particularly acid leftovers) should be returned to the Laboratory sink for disposal.*

CAUTION: *Use extra caution when handling cleaning solution as it contains acid.* **Wear rubber gloves and adequate facial protection when handling acid.** *Follow all A1100091, 94, MSDS safety procedures.*

a) Set up the cleaning supplies where you plan to do the cleaning. Lay out the sensor cleaning brush, syringe, cleaning solutions and rinse solutions, plus your beakers and sensor.
Note: *Ensure your Cleaning Solution beaker is on a firm flat surface since it will contain acid.*

b) First remove the pH sensor from the process and examine it for deposits. Use the sensor cleaning brush and tap rinse water to loosen and flush away any deposits within the cell measurement area. Detergent can be added to remove oil films and non-tenacious deposits. Hard scales and other tenacious deposits may require chemical cleaning.

c)**CHEMICAL CLEANING** Fill a beaker ¾ full of pH electrode wash solution A1100091.

d)Lower the pH sensor into the center of the beaker until the whole tip is submerged.

e) Keep removing, re-immersing the pH sensor until the pH electrode and reference junction appear clean. Stubborn deposits can be removed with the brush and syringe to squirt wash solution into hard to reach areas.
CAUTION: *Use great care when brushing and squirting acid*. **Wear rubber gloves and facial protection.**

f)Rinse the cleaned sensor thoroughly in tap water and then with Demin in the Syringe, for a 2nd rinse before calibrating.

g) Check the sensor against a pH buffer near the application pH. If the sensor is still not reading properly (+/- 0.5pH) in the buffer, re-clean using Gentle Scale Remover, A1100094, steps h) to l).

h)**CHEMICAL DESCALING** Fill a beaker ¾ full of Gentle Scale Remover, A1100094.

i)Lower the pH sensor into the center of the beaker until the whole tip is submerged.

j) Keep removing, re-immersing the pH sensor until the pH electrode and reference junction appear clean. Stubborn deposits can removed with the brush and a syringe of Scale Remover.
CAUTION: *Use great care when brushing and squirting acid*. **Wear rubber gloves and facial protection.**

kRinse the cleaned sensor thoroughly in tap water and then with Demin in the Syringe, for a 2nd rinse before calibrating..

l) Check the sensor against a pH buffer near the application pH.

m) A clean and rinsed pH sensor should read near 7 in pH 7 buffer. If it does not, troubleshoot the pH sensor, wiring, and analyzer, and/or proceed to *Restoring Electrode Response.*

Available Supplies:

A1100090	pH Storage Soln.,	-6P=6pk
A1100091	pH Wash Soln.,	-6P=6pk
A1100092	pH Renew Soln.,	-6P=6pk
A1100094	Gentle Scale Remover,	-6P=6pk
A1100192	Demin Water for Rinse,	-6P=6pk
A1100228	Anti Coat for pH, 100ml	
A7400020	poly Beaker	
A7400031	10 mL Syringe	
A1100016	Brush Sensor Clean	
A1600050	pH Calibration Kit	
A1100051	Red 4 pH Buffer	-6P=6pk
A1100052	Green 7 pH Buffer	-6P=6pk
A1100053	Blue 10 pH Buffer	-6P=6pk
A1900334	Trace to NIST Cert. for pH Buffers.	

pH Sensor Troubleshooting

In order to troubleshoot a pH sensor it is very important to be certain that the analyzer used for troubleshooting is functioning correctly.

IC CONTROLS manufactures a portable pH analyzer and pH calibrator (model 659) for this purpose. The calibrator can be used to prove the portable pH analyzer before use, or it can be used to prove the process pH analyzer where a problem has been exhibited.

Before testing your pH sensors, be sure your test analyzer is known to be good.

FIRST: Inspect electrodes and if dirty or scaled:

a) Clean with soft cloth
b) Acid clean to remove scale (we recommend the Chemical Cleaning procedure above).

SECOND: Run buffer tests in:

(but do not adjust analyzer)
— 7.0, write down reading and response time
— 4.0, write down reading and response time

Slow response? Clean again, or acid clean overnight in electrode wash solution A1100091. Make sure that after cleaning response is not more than 3 minutes.

REFERENCE: If pH 7.0 reads between 6 and 8 then reference is good. If outside 6 to 8 then reference is poor or has failed.

pH GLASS: Subtract pH 4.0 reading from pH 7.0 reading.
— if 2.5 to 3.0 is the result, the glass is good.
— if less than 2.5 then the pH electrode is failing and should be replaced.
Less responsive pH electrodes can sometimes be regenerated with A1100092 electrode renew solution. See *Restoring Electrode Response.*

THIRD: If pH sensor passes tests, then it is good.

Place electrode back in the loop and then run a 2-buffer calibration following the instructions in this instruction manual.

FOURTH: If the sensor fails tests:

a) Replace the pH sensor
b) Consider returning sensor to IC Controls for failure analysis if electrode life seems short.

IC CONTROLS offers a free electrode and application analysis that may help increase electrode life in your application. example of

analysis is: Slow Response — which is typically due to excessive sample line length and low flow, thus producing long sample transport time to the pH sensor from the sample point. Resolve by adding a fast-flow loop with the sensor in a short side stream, or by shortening the line.
Slow response can also be caused by a buildup of dirt in the sample line. In this case the problem may be alleviated by changing the sample point or by installing a dirt settling pot.

Troubleshooting Tips for pH

Readings spike — characteristic of bubbles in the sample line passing through the sensor or sticking to the pH sensor. Also characteristic of pickup from interference pulses generated from AC lines, when AC loads go offline.

Readings gradually drifting away — the pH sensor can no longer be calibrated. This problem is typical of scale or sludge/slime deposits on the pH glass. The sensor may need to be cleaned. Try Anti-Coating Treatment for pH Sensors P/N A1100228.

Readings at maximum — under all conditions.

Either the sensor is in air or there is a problem with the wiring/analyzer setup. Test for shorts by disconnecting BNC and checking impedance between center pin and outside housing with sensor in air. Insulation value should exceed 100 MΩ (megaohm).
If the sensor is OK then use a 659 portable Calibrator / Analyzer to test the preamp, wiring and the analyzer. If the problem persists with the 659 in place then it is an analyzer problem

If the sensor tests as still good, and the analyzer and wiring works with the 659, but the "+Err" or over scale still occur when the analyzer and sensor are hooked up and placed in service, then the most likely cause is a ground loop short forming, not actually a pH sensor problem. See the 659 manual trouble testing procedures to resolve this, pH loop, plant site, interaction problem.

The above symptoms cover most difficulties associated with pH sensors. The key to isolating problems in the pH sensor or analyzer is being able to separate the two with a 659 simulation. However for the most difficult problems, assistance is available from
IC CONTROLS; call toll free at 1(800)265-9161 or (519) 941-8161.

Restoring Electrode Response

Used electrodes which are mechanically intact but low efficiency or slow responding, can often be restored to full response by one of the following procedures:

1. Scale deposits:
Dissolve the deposit by immersion of the electrode tip, overnight (or over weekend), in electrode wash solution P/N A1100091, followed by rinse in tap water. Soak in electrode storage solution P/N A1100090 for 1 to 2 hours.

Difficult cases Repeat substituting gentle scale remover P/N A1100093, then 15 minute rinse.

2. Oil or grease films:
Wash electrode tip with detergent and water. If film is known to be soluble in a particular organic solvent, wash with this solvent. Rinse electrode tip with tap water. Let sit in deionized water P/N A1100015 for 2 to 4 hours, followed by 2 to 4 hours in electrode storage solution P/N A1100090.

Difficult cases Repeat, using wash in Sodium Hypo chlorite (Javex Bleach) in water solution, adjusted to pH 6.5 ±.5 with Vinegar or acid.

3. Plugged or dry reference junction:
Remove the contaminant with one of the above procedures, then soak in electrode storage solution P/N A1100090 for 24 hours to one week.

Difficult cases Repeat but heat almost to boiling for 1/2 hour first, then soak in electrode storage solution P/N A1100090 for 24 hours to one week.

4. Biological Growths:

Wash electrode tip with detergent and water

Difficult cases Wash with Sodium Hypo chlorite (Javex Bleach) in water solution, adjusted to pH 6.5 ±.5 with Vinegar or acid. Use rubber gloves, and wash until deposits fall off or turn white. Rinse tip with tap water. Let sit in deionized water P/N A1100015 for 2 to 4 hours, then 2 to 4 hours in electrode storage solution P/N A1100090.

5. Clean but, Slow and Less Than 85% Eff:

Wash electrode tip with electrode renew solution P/N A1100092 for 15 minutes, Rinse electrode tip 15 minutes with tap water. Let sit in deionized water P/N A1100015 for 2 to 4 hours, followed by 2 to 4 hours in electrode storage solution P/N A1100090.

Note: If none of the above procedures succeed in restoring your electrode response it is near the end of its useful life and should be replaced.

NEW pH SENSORS

IC CONTROLS pH sensors are available for the following types or services;

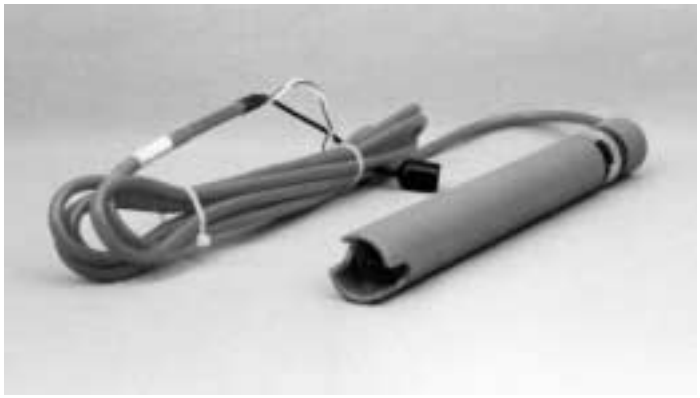
1 submersion service
2 sample side stream service, (flow through)
3 insertion through pipe/tank wall installation
4 insertion with ballvalve for retraction without lowering process pressure.
5 universal type, flow / submersion / insertion
6 pure water (low conductivity) service
7 dirty water (sewer, sludge, mine slurry, pulp stock), service
8 Swing arm mount for high debris in sewage.

Available Sensors are:

pH	SERVICE
602	Light Submersion Sensor [1,2,3]
605	SS Insertion or Ball Valve [1,2,3,4,6,7]
606	SS Ball Valve Retractable safety lip [3,4,7]
607	SS Cartridge Ball Valve Retractable [3,4,7]
615	Pure Water pH [6]
617	High Pressure Retractable [4]
625	Quick Union Universal, Industrial [1,2,3,5]
642	Process Combination “Survivor” [1,2,3,7,8]
643	Ball Valve Retractable “Survivor” [4,7]

Various other options may also be selected, see IC CONTROLS Catalogue for full details, or contact Customer Service at :

www.ICCONTROLS.COM
Phone 1-519-941-8161
FAX 1-519-941-8164



642 Industrial Submersible Combo "The Survivor"

625 Quick Union Universal

615 Pure Water pH

602 Light Industrial Submersible

605 for the strength of SS; insertion or ball valve

617 High Pressure Retractable

606 Ball Valve Type with solid SS blowout stop

Cartridge pH Sensor

643 Ball Valve Retractable "Survivor"

Glossary

Electrode Both a pH sensing electrode and a reference electrode are needed for the analyzer to measure the process. Commonly these are combined and referred to as a pH sensor, or a combination electrode (or combo). The temperature sensor may be built into the electrode as well.

Nernst Equation Equation which relates the voltage signal produced by the electrodes to the pH of the sample. The equation is temperature dependent.

pH The negative logarithm of the Hydrogen Ion concentration in solution. See also pH Definition Pg 5.

pH Glass Electrode A glass of special composition can be made to respond to pH. In order to mount the pH glass a glass shaft is needed. The pH responsive glass mounted on the end of a glass shaft is called a glass pH electrode, or pH sensing electrode. Both a sensing and a reference electrode are needed to measure pH.

pH Sensor Contains both a pH sensing and a reference electrode needed to measure the pH. Also referred to as a pH electrode (or combination electrode). The temperature sensor may be built into the electrode as well.

Reference Electrode A reference electrode generates a known voltage when compared to the Standard Hydrogen Electrode in solution, and while also making an electrical connection to the liquid. The reference electrode provides a second connection to the liquid so the pH responsive voltage of the glass electrode can then be measured. Its known voltage is then subtracted resulting in just the voltage due to pH.

TC Temperature Compensator.

Temperature Compensation Nernstian correction for the influence of temperature on the pH electrode. The analyzer reads out pH as if the process were at 25°C or 77°F, regardless of actual solution temperature.

PARTS LIST

Part #	Description	Note or Dwg #
602 Light Industrial pH Sensor		
602	General purpose pH glass, 3/4 MNPT, 5ft lead, BNC.	see specs for option
605 SS Body Industrial Insertion/Ball Valve Sensor (J-box & Interface. 600)		
605-33	Insertion, GP pH, TC, 6.5" SS body (no J-box, Ball Valve)	see specs for option
605-3-9-11-33	BV Replacemt, Hi pH glass, pulp stock tip, 16.5" long, TC.	see specs for option
A3100002	SS Insertion Gland 3/4 NPT, snsr mount. (605, 403)	
A1100013	Kit O'ring and ferrule for 605 gland fitting (P/N A3100002)	
A1100011	Retainer Cable and Lanyard Set 605	
A3100004	SS Ball Valve 1" NPT	
A7100001	SS reducer 1" NPT to 3/4" NPT	
A7100003	SS Nipple 1" NPT	
A3100062	SS Dense Pulp Stock Flush, reducer with 1/8" port & fitting	
605-11-13-23 Titanium Ball Valve Retractable Sensor (J-box & Interface. 600)		
605-1-9-11-13-33	Replacemt, Hi Temp, Pulp Stock Mod., 16.5" long, Ti, TC.	see specs for option
A2100055	Titanium Ball Valve & fittings, retraction Assy. 1" NPT	
A3100003	Titanium insertion gland, 3/4 NPT	
A7100002	Titanium reducer 1" NPT to 3/4" NPT	
A3100126	Ti D Pulp Stk Fitg & Gland, 4/3 to 1 with 1/8" port & fitting	
A7100004	Titanium Nipple 1" NPT	
605-11-13-26 Titanium Sensor with PVDF Ball Valve (J-box & Interface. 600)		
605-1-9-11-13-33	Replacemt, Hi Temp, Pulp Stock Mod., 16.5" long, Ti, TC.	see specs for option
A2100054	Ti Stock Flush fitgs & PVDF Valve, retraction Assy. 1" NPT	
A3100126	Ti D Pulp Stk Fitg & Gland, 4/3 to 1 with 1/8" port & fitting	
A3100127	Retainer Cable and Lanyard Set for PVDF valve 605-26	
A3100128	Titanium Nipple 1" NPT, big hex for PVDF valve	
605-11-15-27 Hasteloy C Ball Valve Retractable (J-box & Interface. 600)		
605-1-9-11-15-33	Replacemt, Hi T, Pulp Stock Mod., 16.5" long, Hast C, TC.	see specs for option
A2100056	Hasteloy C Ball Valve & fittings, retraction Assy. 1" NPT	
A3100228	Hast-C D Pulp Stk Fitg & Gland, 4/3 - 1 with 1/8" port & ftg	
A3100212	Hasteloy C insertion gland, 3/4 NPT	
606 Ball Valve Retractable pH Sensor with Blowout Stop (J-box & Intrface. 600)		
606-33-71(12")	BV Replacemt, 16.5" long, TC for 655, 12" leads for J-Box.	see specs for option
A2100076	Retainer Fitting Cad 606 3/4" NPT	
A1100011	Retainer Cable and Lanyard Set 605 (for double stop)	
A1100013	Kit O'ring and ferrule for gland fitting	
A2100075	SS insertion gland fitting 3/4" tube, snsr mount 606	
A7201661	SS reducer 1" NPT to A2100075 Gland	
A3100004	SS Ball Valve 1" NPT	
A7100003	SS Nipple 1" NPT	
606 Ball Valve Retractable material & application options		
606-33-71(12")	BV Replacemt, 16.5" long, TC for 655, 12" leads for J-Box.	see specs for option
A3100241	SS D Pulp Stk Fitg & Gland, 4/3 to 1 with 1/8" port & fitting	req sensor opt -9
A2100072	Titanium Ball Valve & fittings, retraction Assy. 1" NPT	req sensor opt -13
A2100073	PVDF Ball Valve & Ti fittings, retraction Assy. 1" NPT	req sensor opt -13
A3100242	Ti D Pulp Stk Fitg & Gland, 4/3 to 1 with 1/8" port & fitting	req snsr opt -9-13
A2100073	Hast C Ball Valve & fittings, retraction Assy. 1" NPT	req sensor opt -15
A3100243	Hast C D Pulp Stk Fitg & Gland, 4/3 - 1 with 1/8" port & fitg	req sensor opt -9-15

Repair and Service

Field Service is dispatched in Canada from the head office of IC CONTROLS. In North America, call 1-800-265-9161, or call 519-941-8161. Outside of North America consult your authorized IC CONTROLS distributor, or:

IC CONTROLS Ltd.
29 Centennial Road
Orangeville, Ontario
CANADA

FAX 519-941-8164

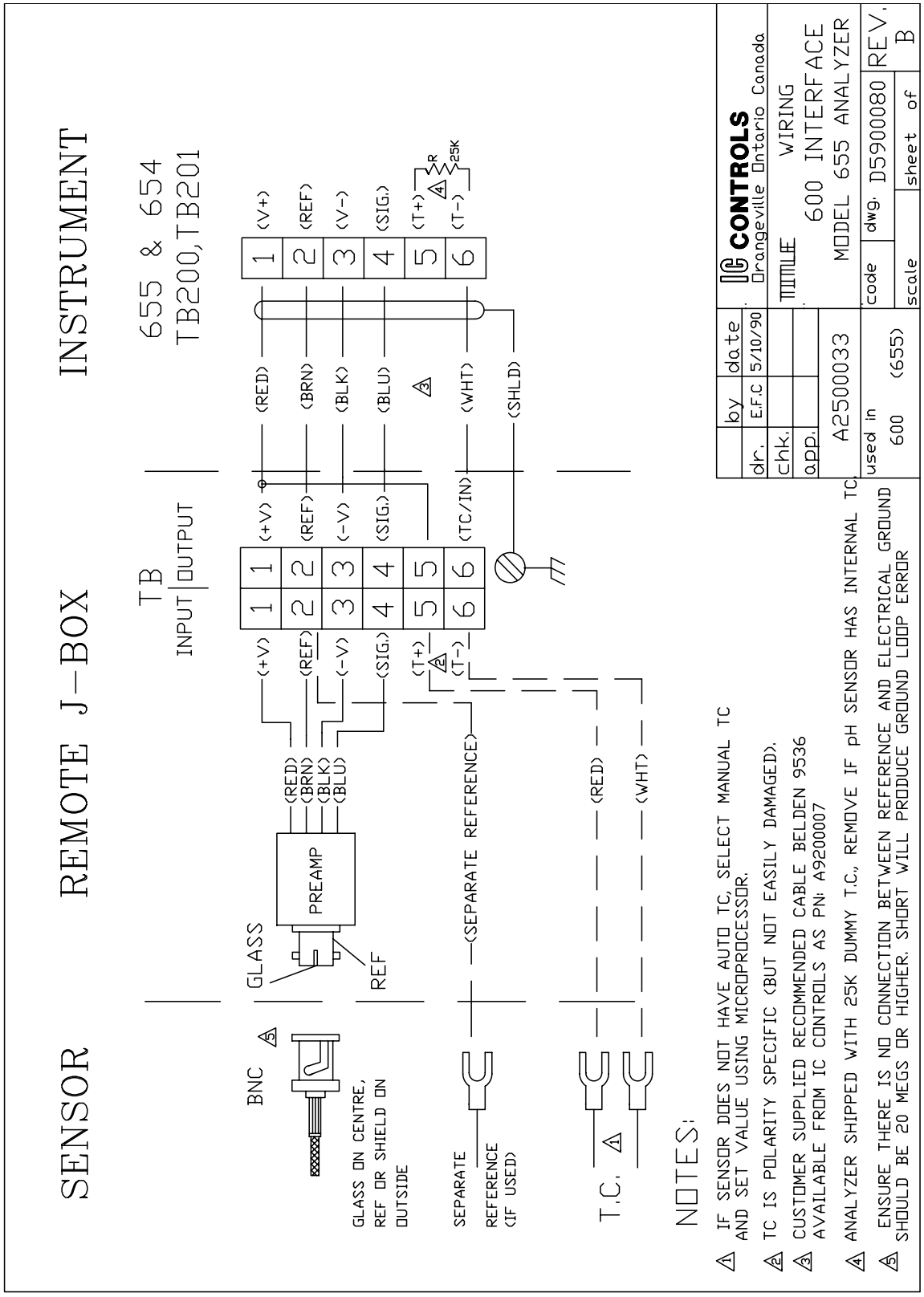
email:
service@iccontrols.com

www.iccontrols.com

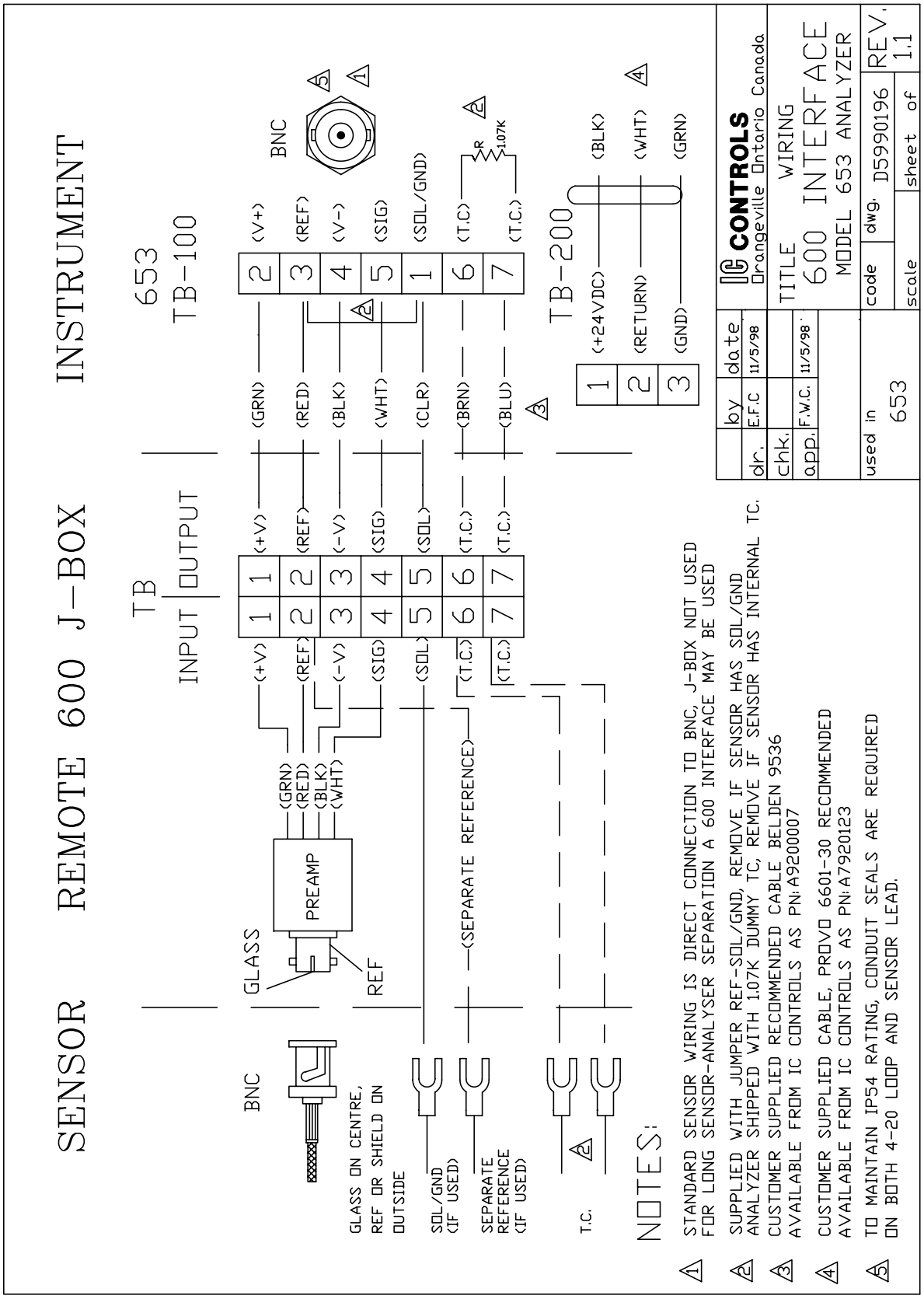
Part #	Description	Note or Dwg #
607 Cartridge Industrial pH Sensor (J-box & Interface. 600)		
607-?-?-?	Replacement Cart. Sensor,-?-? elect options, see specs.	see specs for options
A3100202	Electrode cartridge holder for 8" body	
A3300118	PVDF cartridge retainer for 17 assy, needs A3550703	
A3550703	Nipple coupling retainer to cartridge	
A3100175	SS gland fitting 1" MNPT, for 607	
A3100095	Titanium gland fitting 1" MNPT, for 607	
615 pH Sensor for PURE WATER and CONDENSATES		
615-?-?	Replacement Sensor, see 615 instruction manual.	see specs for options
617 300 PSIG Retractable pH Sensor (J-box & Interface. 600)		
617-?-?	Replacement Sensor,-?-? elect options, see specs.	see specs for options
A2500059	Adapter fitting connects mini-BNC to BNC	
625 Quick Union FLOW, INSERTION, SUBMERSION, Industrial pH Sensor		
625-?-?-?	Replacement pH Sensor, -?-? elect options, see specs	see specs for options
A9551062	Sensor seal O'ring	
A2300091	Replacement Sensor Retainer and Union Ring CPVC	
A2300092	Replacement Sensor Retainer and Union Ring PVDF	
A7201113	Replacement SS Retainer Nut	
A3200090	CPVC flow cell, 1 1/2" SLIP	
A3200073	CPVC flow cell, 1 1/2" FNPT	
A2300074	PVDF flow cell, 1 1/2" FNPT	
A2300075	316 SS flow cell, 1 1/2" FNPT	
A2300086	CPVC union insertion fitting, 1 1/2" MNPT	
A2300087	PVDF union insertion fitting, 1 1/2" MNPT	
A2300088	SS union insertion fitting, 1 1/2" MNPT	
642 INDUSTRIAL SUBMERSION pH Sensor "The Worlds most rugged Survivor"		
641-?-?-?	Replacement pH Sensor, -?-? elect options, see specs	see specs for options
A2100020	Chemical Cleaner Acc. (Pump, Nozzle, Fittings etc.)	see A2100020 Manual
A3600201	Cleaner Nozzle Part that threads on tip	
A2100061	Swing Arm Assy. free standing, for self cleaning in sewers	Req. snsr option -25
A3600121	Tip Screen Assy. 99 mesh. for abrasion protection	Req. snsr opt -21(0)
643 Ball Valve Version of 642 pH Sensor (J-box & Interface. 600) **Max. 50 PSIG**		
643-?-?-?	Replacement pH Sensor, -?-? elect options, see specs	see specs for options
A3600013	1-1/2" CPVC slip insertion fitting, no ball valve.	
A2100077	1-1/2" MNPT CPVC Ball Valve Assy & lanyard set	
600 Interface, Pipe Top, Explosion / Weather-Proof (Recommended over 25')		
A2101513	Explosion proof J-box and O'ring (only)	
A9120098	Terminal block, 6 CKT for A2101513	D5900080 M655
600-71 Interface, Wall Mount Weather-Proof J-Box (Recommended over 25')		
A2101514	Weather proof, wall mount J-box (only)	
A9120050	Terminal strip 6 CKT, for A2101514	D5900080 M655
Interconnect Cable to 600 Interface, J-Box		
A9200006	Cable, preamp to IC Controls M655-54, 5-cond. with shield	D5900080 M655
A9200005	Long run Cbl, over 1000M (3000'), 6-cond & 2 shields	D5900080 M655
A9200007	Cable, preamp to IC Controls M653, 6-cond. with shield	D5990196 M653

DRAWINGS

Sensor Wiring 600-655, D5900080



Sensor Wiring 600-653, D5990196



IC CONTROLS LTD. Head Office, Manufacturing & Research
29 Centennial Road, Orangeville, Ontario, L9W 1R1 Canada Tel: (519) 941-8161 Fax: (519) 941-8164

INDUSTRIAL PRODUCTS WARRANTY

Industrial instruments are warranted to be free from defects in material and workmanship for a period of twelve (12) months from the date of installation or eighteen (18) months from the date of shipment from IC CONTROLS whichever is earlier, when used under normal operating conditions and in accordance with the operating limitations and maintenance procedures in the instruction manual, and when not having been subjected to accident, alteration, misuse, or abuse. This warranty is also conditioned upon calibration and consumable items (electrodes and all solutions) being stored at temperatures between 5°C and 45°C (40°F and 110°F) in a non-corrosive atmosphere. IC CONTROLS consumables or approved reagents must be used or performance warranty is void. Accessories not manufactured by IC CONTROLS are subject to the manufacturer's warranty terms and conditions.

Limitations and exclusions:

Industrial electrodes, and replacement parts, are warranted to be free from defects in material and workmanship for a period of three (3) months from the date of installation or eighteen (18) months from the date of shipment when used under normal operating conditions and in accordance with the operating limitations and maintenance procedures given in the instruction manual and when not having been subjected to accident, alteration, misuse, abuse, freezing, scale coating, or poisoning ions.

Chemical solutions, standards or buffers carry an "out-of-box" warranty. Should they be unusable when first "out-of-box" contact IC CONTROLS immediately for replacement. To be considered for warranty, the product shall have an RA (Return Authorization) number issued by IC CONTROLS customer service department for identification and shall be shipped prepaid to IC CONTROLS at the above address.

In the event of failure within the warranty period, IC CONTROLS, or its authorized dealer will, at IC CONTROLS option, repair or replace the product non-conforming to the above warranty, or will refund the purchase price of the unit.

The warranty described above is exclusive and in lieu of all other warranties whether statutory, express or implied including, but not limited to, any implied warranty of merchantability or fitness for a particular purpose and all warranties arising from the course of dealing or usage of trade. The buyer's sole and exclusive remedy is for repair, or replacement of the non-conforming product or part thereof, or refund of the purchase price, but in no event shall IC CONTROLS (its contractors and suppliers of any tier) be liable to the buyer or any person for any special, indirect, incidental or consequential damages whether the claims are based in contract, in tort (including negligence) or otherwise with respect to or arising out of the product furnished hereunder.

Representations and warranties made by any person, including its authorized dealers, distributors, representatives, and employees of IC CONTROLS, which are inconsistent or in addition to the terms of this warranty shall not be binding upon IC CONTROLS unless in writing and signed by one of its officers.

Appendix A: 655 Spec. Sheet

INTELLIGENT pH ANALYZER

IC CONTROLS has incorporated intelligence into the microprocessor analyzers via the *IC Net*™ Advanced Intelligence Access Program. Measurements such as pH can be critical to your process and must be strictly monitored and maintained. Analyzer Intelligence goes beyond measurement and control; it provides the user with all necessary historical data, including events such as calibration, upsets, diagnostics and more. This information can be communicated for trending or advanced control, even to remote locations. Ultimately, the user has superior control with a competitive advantage.

The analyzer stores the last 12 monthly calibration records for communication or download and even keeps upset records! The last 20 upsets are recorded and date stamped (ie: out of spec, alarm, power interruptions, etc.) Factors leading to alarm conditions are recalled and for measurement trend hundreds of data points can be accessed at user defined time intervals. All of this communication is extremely fast; up to 38k baud.

The optional *IC Net*™ Intelligence Access Program runs in your PC Window using RS485/RS232 and provides your networked PC's access to multiple analyzers. *IC Net*™ allows intelligent system performance that emulates human intelligence through reasoning, manipulation of signals (or advance process control), and remote monitoring (via computer network, DCS, phone, Internet or satellite link).

This analyzer supports and communicates diagnostics! Settings can be viewed, functions tested, calibration updated and remote operated from your computer terminal (Note: requires *IC Net*™ Advanced Intelligence Access Program). An optional Real-Time clock allows accurate tagging of events and duration even through power outages.

Every IC CONTROLS microprocessor analyzer incorporates intelligence that enables advanced process control and the ability to communicate with ease and flexibility - all in one analyzer!
Let IC CONTROLS provide you with REAL SOLUTIONS to your control needs - buy IC CONTROLS Intelligent Analyzers.

The industrial pH instrument from IC CONTROLS, the Model 655, gives you maximum flexibility, reliability, and ease of use.

Intuitive user friendly program, "*just seems to do what you expect* ":

Auto calibration - recognizes your buffers

Self and sensor diagnostics

Fault tolerant

Output hold during calibration

Two programmable 4-20 mA outputs: 1 for acid, 1 for caustic

Dual programmable alarms with self and sensor alert

Optional PID control

Frequent adjustments by keypad prompts

Program remembers what you were doing

No long key sequences

Instant return to sample

Operate without menu or manual

LCD displays pH, temperature, alarm setpoints and calibration status.

EASY MAINTENANCE

Reliable, separately powered and optically isolated output circuit prevents computer interface problems

Alignment controls hidden, but accessible when needed

3 Level Security to protect settings

Calculates pH sensor Slope and Offset

Durable housing withstands hosing down. Survives acid and caustic fumes, humidity, etc.

USE ANY ELECTRODES

Submersible

Flow

Insertion / retractable

USE ANY COMBINATION OF THE FOLLOWING

Local digital indication

4–20 mA signals

4–20 mA Micro PID Control

Adjustable alarms

ON – OFF control

The Model 655 is 115/230 VAC operated.

Model 655

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

	BASIC DESCRIPTION (NETWORKABLE MICROPROCESSOR PH ANALYZER)
MODEL 655	Industrial, input/output isolated INTELLIGENT pH analyzer/controller with NEMA 4X surface type housing. Clear front window shows 4½ digit display selectable for pH, temperature, current output and program messages. Precision ±1 digit (0.01 pH), stability ±2 digits (0.02 pH) per month. 115/230 VAC line operated with serial RS485 plus dual 4-20 mA DC outputs. Future compatible Intelligent Analyzer logs in memory calibration records, alarms, and current measurement trends; or via RS485 two way communication in host real-time log; or sends its memory records on hosts request. Fully program configurable titration curve, and span, within 0-14 pH and -5°C to 105°C (23-221°F). Two relays, alarm on-off control, SPDT 10 Amp 115 VAC resistive; fully programmable setpoint and deadband, second relay may be used for intelligent problem alert. Includes activateable security and one instruction manual. Requires 600 interface and pH sensor temperature compensator option -33 to read temperature. See Option 35, IC Net™ Intelligence Access program for multi-analyzer to networked computers via two-way communication.

ADD	*PROCESS CONTROL OUTPUT OPTIONS - FOR FULL PID PROPORTIONAL PLUS INTEGRAL AND DERIVATIVE ACTIONS*
-1	Single, PID driving 4-20 mA output, with configurable titration curve
-2	Single, PID driving pump pulser output, with configurable titration curve
-3	Single, PID driving time proportional on-off via relay #1, with configurable titration curve
-11	Dual, PID driving two 4-20 mA outputs, with configurable titration curve
-22	Dual, PID driving two pump pulser outputs, relay #1 and #2 with configurable titration curve
-33	Dual, PID driving two time-proportional on-off via relay #1 & #2, with configurable titration curve
-34	Real Time Clock for correct time with the power off
-35	Advanced, IC Net™ Intelligence Access window program for multiple analyzers over one RS485 two-way link to multiple networked workstations. See Computer section.
-36	Binary communication documentation for user to write a custom Intelligence Access program
-37	RS232 Single Analyzer Communication, replaces RS485 loop communication
-38	Reserved for future Fieldbus, replaces RS485
-52	Back Lit Display, uniform green, P/N A9130023
-51	Cleaning / override timer option - uses 1 relay.

ADD	*OPTIONS*
-5	Internal AUDIBLE SONIC ALARM wired to relay A
-6	Integral High Z input (no preamp); must have electrode with no TC or -33P, within 100 ft. maximum
-8	2" pipe/surface mounting kit, P/N A2500255
-9	Panel mounting kit, P/N A2500201
-10	supplied in a 1/2 Din metalic panel mount 144x144mm case (139x139 cutout)
-70(x)	Extra instruction manuals, $ (ea.)
-72(x)	600 Interface Cable, P/N A9200006; specify (x) ft. @ $/ft.
-89	Stainless Steel tag

Sample Order:

655	-11	-	INTELLIGENT pH Analyzer with 2 PID CONTROLS: 1 for acid, 1 for caustic

APPLICATION TIPS:

- For automatic temperature compensation, analyzer requires -33 TC option in pH sensor, -33P if using option -6
- Generally pH loops include an interface to reduce the high electrode impedence if the analyzer is to be mounted at a distance from the pH sensor. See 600 interface and cable, P/N A9200006, good for 1000 ft. or more; if electrode is connected within 25 ft., use -6.

Appendix B: 656 Spec. Sheet

TWO pH SENSOR INTELLIGENT ANALYZER

IC CONTROLS has incorporated intelligence into the microprocessor analyzers via the *IC Net*™ Advanced Intelligence Access Program. Measurements such as pH can be critical to your process and must be strictly monitored and maintained. Analyzer Intelligence goes beyond measurement and control; it provides the user with all necessary historical data, including events such as calibration, upsets, diagnostics and more. This information can be communicated for trending or advanced control, even to remote locations. Ultimately, the user has superior control with a competitive advantage.

The analyzer stores the last 12 monthly calibration records for communication or download and even keeps upset records! The last 20 upsets are recorded and date stamped (ie: out of spec, alarm, power interruptions, etc.) Factors leading to alarm conditions are recalled and for measurement trend hundreds of data points can be accessed at user defined time intervals. All of this communication is extremely fast; up to 38k baud.

The optional *IC Net*™ Intelligence Access Program runs in your PC Window using RS485/RS232 and provides your networked PC's access to multiple analyzers. *IC Net*™ allows intelligent system performance that emulates human intelligence through reasoning, manipulation of signals (or advance process control), and remote monitoring (via computer network, DCS, phone, Internet or satellite link).

This analyzer supports and communicates diagnostics! Settings can be viewed, functions tested, calibration updated and remote operated from your computer terminal (Note: requires *IC Net*™ Advanced Intelligence Access Program). An optional Real-Time clock allows accurate tagging of events and duration even through power outages.

Every IC CONTROLS microprocessor analyzer incorporates intelligence that enables advanced process control and the ability to communicate with ease and flexibility - all in one analyzer!
Let IC CONTROLS provide you with REAL SOLUTIONS to your control needs - buy IC CONTROLS Intelligent Analyzers.

The two sensor pH instrument from IC CONTROLS, the Model 656, gives you maximum flexibility, reliability, and ease of use.

Intuitive user friendly program, "*just seems to do what you expect*":

Auto calibration - recognizes your buffers

Self and sensor diagnostics

Fault tolerant

Output hold during calibration

Two programmable 4–20 mA outputs: 1 for acid, 1 for caustic

Dual programmable alarms with self and sensor alert

Optional PID control

Frequent adjustments by keypad prompts

Program remembers what you were doing

No long key sequences

Instant return to sample

Operate without menu or manual

LCD displays pH, temperature, alarm setpoints and calibration status.

USE YOUR TWO pH ELECTRODES FOR

Redundant back up, switching automatically from electrode A to B on failure.

Intelligent control, pH A responding to input change and pH B responding to outlet pH.

Two separate pH loops.

EASY MAINTENANCE

Reliable, separately powered and optically isolated output circuit prevents computer interface problems

Alignment controls hidden, but accessible when needed

3 Level Security to protect settings

Calculates pH sensor Slope and Offset

Durable housing withstands hosing down. Survives acid and caustic fumes, humidity, etc.

USE ANY ELECTRODES

Submersible

Flow

Insertion / retractable

USE ANY COMBINATION OF THE FOLLOWING

Local digital indication

4–20 mA signals

4–20 mA Micro Control

Adjustable alarms

ON–OFF control

The Model 656 is 115/230 VAC operated.

Model 656

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

	BASIC DESCRIPTION (Networkable Microprocessor Dual pH Analyzer)
MODEL 656	TWO INPUT pH / pH ANALYZER, Industrial, input/output isolated INTELLIGENT with NEMA 4X surface type housing. Clear front window shows 4½ digit display selectable for pH, temperature, current output and program messages. Precision ±2 digit (0.02 pH), stability ±6 digits (0.06 pH) per month. 115/230 VAC line operated with serial RS485 output plus dual 4-20 mA DC outputs. Future compatible Intelligent Analyzer logs in memory calibration records, alarms, and current measurement trends; or via RS485 two way communication in host real-time log; or sends its memory records on hosts request. Fully program configurable span, within 0-14 pH and -5 to 105°C (23-221°F). Two relays, alarm, on-off control, SPDT 10 Amp 115 VAC resistive; fully programmable setpoint and deadband, second relay may be used for intelligent problem alert. Includes one instruction manual. Needs two (2) 600 interfaces and two (2) pH electrodes. See Option 35, IC Net™ Intelligence Access program for multi-analyzer to networked computers via two-way communication.

ADD	*PROCESS CONTROL OUTPUT OPTIONS - FOR FULL PID PROPORTIONAL, PLUS INTEGRAL AND DERIVATIVE ACTIONS*
-1	Single, PID driving 4-20 mA output, with titration curve characterizable input
-2	Single, PID driving pump pulser output, with titration curve characterizable input
-3	Single, PID driving time proportional on-off via one relay, with titration curve characterizable input
-11	Dual, PID drives both 4-20 mA outputs, with separate titration curve characterizable inputs
-12	Example of combinations of dual control (2 types; 1 PID 4-20 mA, 1 PID pump pulser using relay)
-22	Dual, PID drives two pump pulser outputs using both relays, with separate titration curve characterization
-33	Dual, PID drives two time proportional on-off using both relays, with separate titration curve characterization
-41	Remote Setpoint 4-20 input [uses TC input #2, so temperature at both electrodes should be close.]
-42	Remote 4-20 mA input for (Flow) with signal curve characterization to linearize [uses TC input #2]
-43	Dual "ion demand" calculated from inputs, requires -42

ADD	*OPTIONS*
-5	Integral AUDIBLE SONIC ALARM wired to relay A
-8	2" pipe/surface mounting kit, P/N A2500255
-9	Panel mounting kit, P/N A2500201
-10	supplied in a 1/2 Din metalic panel mount 144x144mm case (139x139 cutout)
-34	Real Time Clock for correct time with the power off
-35	Advanced, IC Net™ Intelligence Access window program for multiple analyzers over one RS485 two-way link to multiple networked workstations. See Computer section.
-36	Binary communication documentation for user to write a custom Intelligence Access program
-37	RS232 Single Analyzer Communication, replaces RS485 loop communication
-38	Reserved for future Fieldbus, replaces RS485
-51	Cleaner or override timer option, uses one relay
-52	Back Lit Display, uniform green, P/N A9130023
-61	Redundant electrode switching logic (alarms & switches to second electrode if first electrode deviates)
-62	INTERACT OUTPUT, #1 4-20 mA averages (pH electrode A + pH electrode B)/2 = output
-63	INTERACT PID, First PID output adds to Proportional action of second PID (requires -11 or -12)
-70(x)	Extra instruction manuals. Priced (x) times $ each
-72(x)	600 Interface Cable, P/N A9200006; specify ft(x) @ $/ft.
-89	Stainless Steel tag

Sample Order:

656	-22	-5	Example: ECONOMICAL TWO-TANK EFFLUENT NEUTRALIZATION SYSTEM TWO pH electrode ANALYZER / CONTROLLER, first pH tank with ACID PID control pulsing metering pump #1 and with CAUSTIC PID control pulsing metering pump #2; second pH tank driving 4-20 mA output #2 to record final pH, and SONIC ALARM alert if pH approaches limits.

APPLICATION TIPS:

- 656 must be supplied with 600 interface(s); option -6 is not available (due to no space on case surface for mounting).
- For automatic temperature compensation, analyzer requires -33 TC option in pH sensor.
- Generally, pH loops include an interface to reduce the high electrode impedence if the analyzer is to be mounted at a distance from the pH sensor. See 600 interface and cable P/N A9200006, good for 1000 ft. or more, or A9200003.

Appendix C: 653 Spec. Sheet

MICRO pH / ORP TRANSMITTER

IC CONTROLS has incorporated microprocessor intelligence into these Two-Wire Transmitters. Measurements such as pH and ORP can be critical to your process and must be strictly monitored and maintained. Analyzer Intelligence goes beyond measurement and control; it provides the user with calibration data, including events such as electrode offset, slope and diagnostics. Information can be communicated for trending or advanced control, even to remote locations. Ultimately, the user has superior control with a competitive advantage.

The analyzer stores the last calibration record Settings can be viewed, functions tested, calibration updated without opening the enclosure, by use of the front panel keypad.

Available in an Explosion Proof barrel housing. Useful even in sever plant environments it is always operated with the case sealed. Settings are viewed, functions tested, calibration updated without opening the housing, by use of an infrared remote keypad. The infrared light passes through the front viewing window to operate the micro, just like a TV. The remote can individually address any one of a group of units mounted together.

These Analyzers / Transmitters are 2-wire 24 VDC operated. Installation costs are less because no 115/240 VAC is needed at the transmitter field location. They require a separate 24 VDC supply and typically a 4-20 mA receiver.

Let IC CONTROLS provide you with REAL SOLUTIONS to your control needs - buy IC CONTROLS Microprocessor Two-Wire Transmitters.

The industrial microprocessor two-wire pH/ORP transmitter from IC CONTROLS, the Model 653, gives you maximum flexibility, reliability, and ease of use. The transmitter is easily applied and panel mounts in a standard 1/2 DIN size RFI/EMI resistant case, with options available for pipe or wall mount. When needed a very rugged explosion proof case, option -9, is also available.

This is not just a Transmitter, it is a full pH or ORP Analyzer! You get full electrode functions, Standardize (reference offset) and Slope (measurement efficiency), plus independent program adjustable 4-20 mA zero and span. Even with old deteriorated electrodes, you enjoy higher accuracy over the full pH or ORP scale. This Analyzer corrects for the low efficiency and large offsets typical of electrode age, to give corrected precision readings.

Intuitive user friendly program, "*just seems to do what you expect* ":

Field configures by simple "select" pH or ORP

Auto calibration - recognizes your buffers

Self and sensor diagnostics

Output hold during calibration

Reversible, programmable 4-20 mA zero and span

Adjustments by keypad or infrared remote.

Program remembers what you were doing

Instant return to sample, quickly locates you

Easy to operate without menu or manual

LCD displays pH, ORP, temperature, mA output and calibration status.

EASY MAINTENANCE

Reliable, separately powered and input-output isolated circuit prevents computer interface problems

Calculates pH sensor Slope and Offset

Durable IP65 (Nema 4X) housing withstands hosing down. Survives acid and caustic fumes, humidity, etc.

USE ANY ELECTRODES

Submersible

Flow

Insertion / retractable

USE ANY OF THE FOLLOWING

Local digital indication

4–20 mA signal

IC Net™ Intelligence communication

Optional HART® analyzer communication

The Model 653 is 24 VDC Two-Wire loop operated.

Model 653

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

	BASIC DESCRIPTION (MICROPROCESSOR PH/ORP TRANSMITTER)
MODEL 653	Industrial, input/output isolated microprocessor pH/ORP Transmitter with IP65 (NEMA 4X) panel type 1/2 DIN housing. Clear front window shows 4½ digit display selectable for pH or ORP mV, temperature (C or F), current output and program messages. Precision ±1 digit (0.01 pH), stability ±2 digits (0.02 pH) per month. 24 VDC 2-wire operated with fully program configurable 4-20 mA output, within 0-14 pH, +2000-0- -2000 ORP mV, and -5°C to 105°C (23-221°F). Includes one instruction manual. Requires pH sensor temperature compensator option -34 (or -34P) sold separately.

ADD	*(FUTURE) OUTPUT OPTIONS, (Note: a 4-20 mA is included)*
-35	(Future) Advanced, IC Net™ Intelligence Access window program for multiple analyzers over one serial two-way link t multiple networked workstations. See Computer section.
-37	(Future Hart) Analyzer Communication, replaces IC Net™ loop communication
-38	Reserved for future Fieldbus, replaces IC Net™

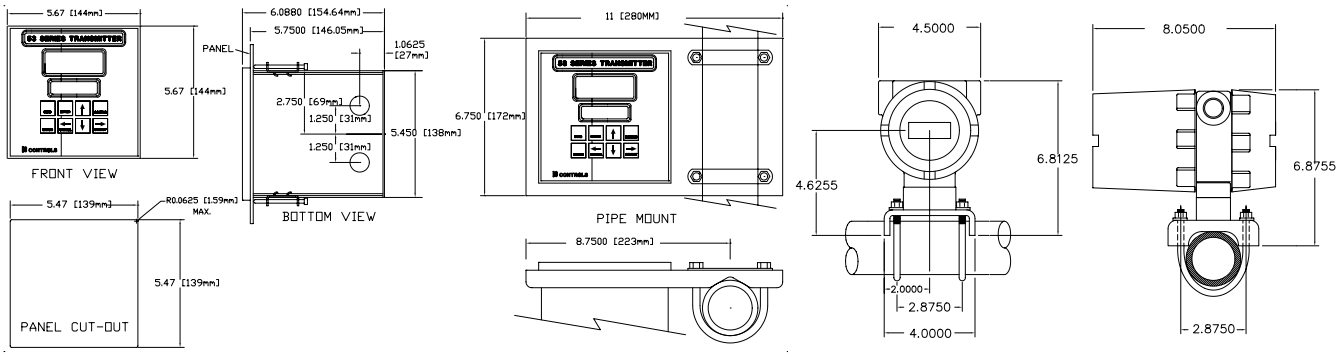
ADD	*OPTIONS*
-1	Configured for use with 600 interface and preamp (included); electrode within 1000 ft. maximum
-5	24 VDC power supply model 540 (115 or 230 VAC +/- 10% 50/60 Hz)
-6	Intrinsic safe barrier
-7	Wall mounting kit, P/N A2500268
-8	2" pipe mounting kit, P/N A2500267
-9	Explosion proof, class 1, Div. 1, barrel housing kit (requires opt -10 remote keypad)
-10	Remote control keypad, intrinsic safe infra-red, operates one or more transmitters individually.
-70(x)	Extra instruction manuals, $ (ea.)
-72(x)	600 Interface Cable, P/N A9200006; specify (x) ft. @ $/ft.
-89	Stainless Steel tag

Sample Order:

653	-	-8	MICROPROCESSOR pH Transmitter, with pipe mounting kit

APPLICATION TIPS:

- For automatic temperature compensation, analyzer requires -34 TC option in pH sensor
- Generally pH loops include an interface to reduce the high electrode impedence if the analyzer is to be mounted at a distance from the pH sensor. See 600 interface and cable, P/N A9200006, good for 1000 ft. or more; if electrode is connected within 25 ft., it should be direct connected.
- Two-wire 24V DC instruments require a power supply. To specify IC CONTROLS 2-wire power supply, see option -5
- Alarms can be added remotely using Model 585 Signal Conditioner



Appendix D: 659 Spec Sheet

PORTABLE CALIBRATOR / ANALYZER

IC CONTROLS has incorporated intelligence into the microprocessor analyzers via the *IC Net*™ Advanced Intelligence Access Program. Measurements such as pH can be critical to your process and must be strictly monitored and maintained. Analyzer Intelligence goes beyond measurement and control; it provides the user with all necessary historical data, including events such as calibration, upsets, diagnostics and more. This information can be communicated for trending or advanced control, even to remote locations. Ultimately, the user has superior control with a competitive advantage.

The analyzer stores the last 12 monthly calibration records for communication or download and even keeps upset records! The last 20 upsets are recorded and date stamped (ie: out of spec, alarm, power interruptions, etc.) Factors leading to alarm conditions are recalled and for measurement trend hundreds of data points can be accessed at user defined time intervals. All of this communication is extremely fast; up to 38k baud.

The optional *IC Net*™ Intelligence Access Program runs in your PC Window using RS485/RS232 and provides your networked PC's access to multiple analyzers. *IC Net*™ allows intelligent system performance that emulates human intelligence through reasoning, manipulation of signals (or advance process control), and remote monitoring (via computer network, DCS, phone, Internet or satellite link).

This analyzer supports and communicates diagnostics! Settings can be viewed, functions tested, calibration updated and remote operated from your computer terminal (Note: requires *IC Net*™ Advanced Intelligence Access Program). An optional Real-Time clock allows accurate tagging of events and duration even through power outages.

Every IC CONTROLS microprocessor analyzer incorporates intelligence that enables advanced process control and the ability to communicate with ease and flexibility - all in one analyzer!
Let IC CONTROLS provide you with REAL SOLUTIONS to your control needs - buy IC CONTROLS Intelligent Analyzers.

The Model 659 is a portable pH analyzer and calibration instrument for pH analyzers and electrodes, all in one case.

Supplied with a rugged combination pH electrode, it can be used for grab sample pH or to prove the accuracy of pH analyzers.

Calibrate any type or make of pH analyzer. The 659 puts out an artificial pH signal based on the Nernst equation for glass pH electrode response that is universal to pH.

Analyzer portion can not only read the calibration output with precision, but also can read real pH electrodes. Hook up a combination pH electrode and use as a portable pH meter, or hook up your on-line pH electrodes to confirm their operating condition.

BENEFITS

Durable design in portable non-corrosive case.

Easily isolates pH loop problems by allowing the service technician to individually prove the status of the analyzer, the wiring, the preamp, the electrode, or the reference electrode.

Favorite of service technicians!

handy feature that flips simulated pH electrode zero and span outputs for easy analyzer calibration

powerful signal drive to prove the operation of marginal electronics, then switch to high meg to test isolation integrity at pH electrode impedance levels.

connect process electrodes to 659 analyzer and prove each one works; by substituting known good grab sample reference electrode, or pH glass, with process electrode.

displays results to 0.01 pH precision.

checks true pH with grab sample test

switch it to millivolts and you now have an ORP calibrator (and/or millivolt source).

Model 659

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL	ADD			BASIC DESCRIPTION (complete unit)
659				Industrial, hand-held, field, bench top, analyzer/calibrator/digital pH meter. 0.0 to 14.0 pH and 0-2.00 volts LCD display has inputs for both combination and separate pH, reference electrodes. Simulator outputs pH in unit steps from 1 to 14 or flips equal distance either side of 7 (eg. 4 to 10, 0 to 14). Tests wiring, preamp, etc. integrity with 100 meg load. Includes Model 602 heavy duty portable combination electrode, and one instruction manual.
	ADD			RECOMMENDED FLEXIBILITY OPTIONS
	-1			Included standard 6" cable, readout simulator on analyzer, P/N A2500041
	-2			Included std. BNC tee; readout simulator both on analyzer and on equipment under test, P/N A9120006
	-3			Carrying case, P/N A2500044
	-4			BNC switch box separates glass and ref.in combo electrode & tests for ground loops, P/N A9120005
		ADD		CABLES WITH FITTINGS FOR ANALYZER TESTING
		-5		Included std. BNC 3' long for IC Controls analyzers (others with BNC inputs), P/N A2500042
		-6		BNC and pin (grounded shield inputs). P/N A2500043
		-7		Alligator clips (screw terminal inputs), P/N A2500040
		-8		US Std. & pin (lab analyzers), P/N A1100012
		-9		Special (user supplies sample from old electrode)
			ADD	CALIBRATION SUPPLIES OPTIONS
			-10	color coded 500ml buffer 6-pack: 4, 7, & 10 P/N A1100054
			-11	Buffer 4.0 pH, 500 mL, red, P/N A1100051. For Pure Water see P/N A1100216
			-12	Buffer 7 pH, 500 mL, green, P/N A1100052. For Pure Water see P/N A1100217
			-13	Buffer 10 pH, 500 mL, blue, P/N A1100053. For Pure Water see P/N A1100218
			-14	3 beakers, 250 mL, P/N A1100020
			-15	Squeeze bottle, P/N A1100014
			-16	4 500ml bottles demin water, P/N A1100192
			ADD	MANUALS
			-70(x)	Extra instruction manuals (x) $ per Copy
			-89	Stainless steel tag

Sample Order:

659	-1-2	-5	-10	pH Calibrator and Analyzer with pH Buffer calibration 6-Pack

RECOMMENDATION FOR CALIBRATION AND SERVICE SUPPLIES:

Minimum: Color coded 4, 7 & 10 buffers. (P/N A1100054)

Normal: pH service kit. (P/N A1600050)
- 1 year calibration supply: 3 color-coded buffers (4 red, 7 green, 10 blue) in 6-packs.
- electrode washing solution (A1100091)
- four 250mL plastic beakers (A1100020)
- 1 squeeze bottle (A1100014)
- 6-pack deionized water, 500 mL bottles (A1100192-6P)

Appendix E: 657 Spec Sheet

pH/ORP TWO-SENSOR
INTELLIGENT ANALYZER

IC CONTROLS has incorporated intelligence into the microprocessor analyzers via the *IC Net*™ Advanced Intelligence Access Program. Measurements such as pH and ORP can be critical to your process and must be strictly monitored and maintained. Analyzer Intelligence goes beyond measurement and control; it provides the user with all necessary historical data, including events such as calibration, upsets, diagnostics and more. This information can be communicated for trending or advanced control, even to remote locations. Ultimately, the user has superior control with a competitive advantage.

The analyzer stores the last 12 monthly calibration records for communication or download and even keeps upset records! The last 20 upsets are recorded and date stamped (ie: out of spec, alarm, power interruptions, etc.) Factors leading to alarm conditions are recalled and for measurement trend hundreds of data points can be accessed at user defined time intervals. All of this communication is extremely fast; up to 38k baud.

The optional *IC Net*™ Intelligence Access Program runs in your PC Window using RS485/RS232 and provides your networked PC's access to multiple analyzers. *IC Net*™ allows intelligent system performance that emulates human intelligence through reasoning, manipulation of signals (or advance process control), and remote monitoring (via computer network, DCS, phone, Internet or satellite link).

This analyzer supports and communicates diagnostics! Settings can be viewed, functions tested, calibration updated and remote operated from your computer terminal (Note: requires *IC Net*™ Advanced Intelligence Access Program). An optional Real-Time clock allows accurate tagging of events and duration even through power outages.

Every IC CONTROLS microprocessor analyzer incorporates intelligence that enables advanced process control and the ability to communicate with ease and flexibility - all in one analyzer!
Let IC CONTROLS provide you with REAL SOLUTIONS to your control needs - buy IC CONTROLS Intelligent Analyzers.

The two sensor pH/ORP instrument from IC CONTROLS, the Model 657, gives you maximum flexibility, reliability, and ease of use.

Intuitive user friendly program, "*just seems to do what you expect* **":**

- Auto calibration - recognizes your buffers
- Self and sensor diagnostics
- Fault tolerant
- Output hold during calibration
- Two programmable 4–20mA outputs with optional PID control
- Dual programmable alarms with self and sensor alert
- Frequent adjustments by keypad prompts
- Program remembers what you were doing
- No long key sequences and instant return to sample
- Operate without menu or manual
- LCD displays pH, temperature, alarm setpoints and calibration status.

USE YOUR pH/ORP ELECTRODES FOR

- Economical Cyanide Destruction System, only (2) 657's: one for Cyanide to Cyanate and the other for Cyanate to Carbonate and Neutralize.
- Economical Batch Chrome Reduction System, Batch logic pH Neutral, ORP to Reduce, pH to neutralize, then final pH before discharge.
- Two separate loops: pH and ORP.

EASY MAINTENANCE

- Reliable, separately powered and optically isolated output circuit prevents computer interface problems
- Alignment controls hidden, but accessible when needed
- 3 Level Security to protect settings
- Calculates pH sensor Slope and Offset
- Durable housing withstands hosing down. Survives acid and caustic fumes, humidity, etc.

USE ANY ELECTRODES

- Submersible
- Flow
- Insertion / retractable

USE ANY COMBINATION OF THE FOLLOWING

- Local digital indication
- 4–20 mA signals
- 4–20 mA Micro Control
- Adjustable alarms
- ON–OFF control

The Model 657 is 115/230 VAC operated.

Model 657

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL 657	*BASIC DESCRIPTION (Networkable Microprocessor pH / ORP Analyzer)* TWO INPUT pH / ORP ANALYZER, Industrial, input/output isolated INTELLIGENT with NEMA 4X surface type housing. Clear front window shows 4½ digit display selectable for pH, ORP (mV), temperature, mA output and program messages. Precision ±2 digit (0.02 pH), stability ±6 digits (0.06 pH) per month. 115/230 VAC line operated with serial RS485 output plus dual 4-20 mA DC outputs. Future compatible Intelligent Analyzer logs in memory calibration records, alarms, and current measurement trends; or via RS485 two way communication in host real-time log; or sends its memory records on hosts request. Fully program configurable span, within 0-14 pH and -1000 to 0 to +1000mV. Two relays, alarm, on-off control, SPDT 10 Amp 115 VAC resistive; fully programmable setpoint and deadband, second relay may be used for intelligent problem alert. Includes one instruction manual. Requires two (2) 600 interfaces, 1 pH and 1 ORP electrode. See Option 35, IC Net™ Intelligence Access program for multi-analyzer to networked computers via two-way communication.

ADD	*PROCESS CONTROL OUTPUT OPTIONS - FOR AVAILABLE FULL PID PROPORTIONAL, PLUS INTEGRAL AND DERIVATIVE ACTIONS*
-1	Single, PID driving 4-20 mA output, with titration curve characterizable input
-2	Single, PID driving pump pulser output, with titration curve characterizable input
-3	Single, PID driving time proportional on-off via one relay, with titration curve characterizable input
-11	Dual, PID drives both 4-20 mA outputs, with separate titration curve characterizable inputs
-12	Example of combinations of dual control (2 types; 1 PID 4-20 mA, 1 PID pump pulser using relay)
-22	Dual, PID drives two pump pulser outputs using both relays, with separate titration curve characterization
-33	Dual, PID drives two time propotional on-off using both relays, with separate titration curve characterization
-41	Remote Setpoint 4-20 input pH [uses TC input #2, so temperature at both electrodes should be close.]
-42	Remote Setpoint 4-20 input ORP [uses TC input #2, so temp. at both electrodes should be close.] (not available with -41)
-44	Batch Cyanide ion destruct logic

ADD	*OPTIONS*
-8	2" pipe/surface mounting kit, P/N A2500255
-9	Panel mounting kit P/N, A2500201
-10	supplied in a 1/2 Din metalic panel mount 144x144mm case (139x139 cutout)
-34	Real Time Clock for correct time with the power off
-35	Advanced, IC Net™ Intelligence Access window program for multiple analyzers over one RS485 two-way link to multiple networked workstations. See Computer section.
-36	Binary communication documentation for user to write a custom Intelligence Access program
-37	RS232 Single Analyzer Communication, replaces RS485 loop communication
-38	Reserved for future Fieldbus, replaces RS485
-51	Cleaner or override timer option, uses one relay. Cannot be used with -41 or -42
-52	Back Lit Display, uniform green, P/N A9130023
-70(x)	Extra instruction manuals. Priced (x) times $ each
-72(x)	600 Interface Cable, P/N A9200006; specify ft(x) @ $/ft.
-89	Stainless Steel tag

Sample Order:

				TWO-TANK CONTINUOUS EFFLUENT CYANIDE DESTRUCTION SYSTEM (A & B)
A	657	-	-	First tank (Cyanide to Cyanate) with CAUSTIC on-off control metering pump #1 and with HYPOCHLORITE ORP on-off control of metering pump #2. Requires (2) 642 electrodes, (2) 600 interfaces, and pumps.
B	657	-2	-	Second (Cyanate to Carbonate plus Neutralize) tank with Hypochorite ORP on-off control of metering pump #1 and with PID pH control of acid metering pump #2 to neutralize, plus 4-20 mA to record pH. Requires (2) 642, (2) 600 interfaces, and pumps.
	657	-2	-44	ECONOMICAL SINGLE TANK BATCH CYANIDE DESTRUCTION pH/ORP ANALYZER/CONTROLLER First relay drives caustic on-off,second relay drives hypochlorite on-off; first 4-20 mA output drives acid neutralize, second 4-20 mA output drives pH recorder. Requires (2) 642, (2) 600 Interfaces, (1) recorder, and (3) pumps.

APPLICATION TIPS:

- 657 must be supplied with 600 interface(s), option -6 is not available (due to no space on case surface for mounting).
- For automatic temperature compensation, analyzer requires -33 TC option in pH sensor.
- Generally, pH loops include an interface to reduce the high electrode impedence if the analyzer is to be mounted at a distance from the pH sensor. See 600 interface and cable P/N A9200006, good for 1000 ft. or more, or A9200003.
- See 657 Instruction Manual for Cyanide Destruction system setup and pH/ORP setpoints.

Appendix F: 654 Spec Sheet

INTELLIGENT ORP ANALYZER

IC CONTROLS has incorporated intelligence into the microprocessor analyzers via the *IC Net*™ Advanced Intelligence Access Program. Measurements such as ORP can be critical to your process and must be strictly monitored and maintained. Analyzer Intelligence goes beyond measurement and control; it provides the user with all necessary historical data, including events such as calibration, upsets, diagnostics and more. This information can be communicated for trending or advanced control, even to remote locations. Ultimately, the user has superior control with a competitive advantage.

The analyzer stores the last 12 monthly calibration records for communication or download and even keeps upset records! The last 20 upsets are recorded and date stamped (ie: out of spec, alarm, power interruptions, etc.) Factors leading to alarm conditions are recalled and for measurement trend hundreds of data points can be accessed at user defined time intervals. All of this communication is extremely fast; up to 38k baud.

The optional *IC Net*™ Intelligence Access Program runs in your PC Window using RS485/RS232 and provides your networked PC's access to multiple analyzers. *IC Net*™ allows intelligent system performance that emulates human intelligence through reasoning, manipulation of signals (or advance process control), and remote monitoring (via computer network, DCS, phone, Internet or satellite link).

This analyzer supports and communicates diagnostics! Settings can be viewed, functions tested, calibration updated and remote operated from your computer terminal (Note: requires *IC Net*™ Advanced Intelligence Access Program). An optional Real-Time clock allows accurate tagging of events and duration even through power outages.

Every IC CONTROLS microprocessor analyzer incorporates intelligence that enables advanced process control and the ability to communicate with ease and flexibility - all in one analyzer!
Let IC CONTROLS provide you with REAL SOLUTIONS to your control needs - buy IC CONTROLS Intelligent Analyzers.

The industrial ORP instrument from IC CONTROLS, the Model 654, gives you maximum flexibility, reliability, and ease of use.

Intuitive user friendly program, "*just seems to do what you expect***":**

- Auto calibration - recognizes your standards
- Self diagnostics
- Fault tolerant
- Output hold during calibration
- Two programmable 4-20 mA outputs
- Dual programmable alarms with self and sensor alert
- Optional PID control
- Frequent adjustments by keypad prompts
- Program remembers what you were doing
- No long key sequences
- Instant return to sample
- Operate without menu or manual
- LCD displays +1999 to 0 to 1999 mV, temperature, alarm setpoints and calibration status

EASY MAINTENANCE

- Reliable, separately powered and optically isolated output circuit prevents computer interface problems
- Alignment controls hidden, but accessible when needed
- 3 Level Security to protect settings
- Durable housing withstands hosing down. Survives acid and caustic fumes, humidity, etc.

USE ANY ELECTRODES

- Submersible
- Flow
- Insertion / retractable

USE ANY COMBINATION OF THE FOLLOWING

- Local digital indication
- 4–20 mA signals
- 4–20 mA Micro PID Control
- Adjustable alarms
- ON–OFF control

The Model 654 is 115/230 VAC operated.

Model 654

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL 654	*BASIC DESCRIPTION (NETWORKABLE MICROPROCESSOR ORP ANALYZER)*	
	Industrial INTELLIGENT ORP analyzer/controller, input/output isolated with NEMA 4X surface type housing. Clear front window shows 4½ digit display selectable for ORP, temperature, current output and program messages. Precision ±1 digit, stability ±2 digits, window ±900 mV, zero offset ±1000 mV maximum. Future compatible Intelligent Analyzer logs in memory calibration records, alarms, and current measurement trends; or via RS485 two way communication in host real-time log; or sends its memory records on hosts request. 115/230 VAC line operated with dual 4-20 mA DC outputs, fully program assignable for span, within ±900 mV window and -5 to 105°C (23-221°F). Two relays, alarm on-off control, SPDT 10 Amp 115 VAC resistive; fully programmable setpoint and deadband, second relay may be used for intelligent problem alert. Includes one instruction manual. Requires 600 interface and ORP electrode. See Option 35, IC Net™ Intelligence Access program for multi-analyzer to networked computers via two-way communication.	
	ADD	*PROCESS CONTROL OUTPUT OPTIONS - FOR FULL PROPORTIONAL, PLUS INTEGRAL AND DERIVATIVE ACTIONS*
	-1	Single, PID driving 4-20 mA output
	-2	Single, PID driving pump pulser output
	-3	Single, PID driving time proportional on-off via relay #1
	ADD	*OPTIONS*
	-5	Integral AUDIBLE SONIC ALARM wired to relay A
	-6	Integral High Z input (no preamp); electrode should be within 100 ft. for good results
	-8	2" pipe/surface mounting kit, P/N A2500255
	-9	Panel mounting kit, P/N A2500201
	-10	supplied in a 1/2 Din metalic panel mount 144x144mm case (139x139 cutout)
	-34	Real Time Clock for correct time with the power off
	-35	Advanced, IC Net™ Intelligence Access window program for multiple analyzers over one RS485 two-way link to multiple networked workstations. See Computer section.
	-36	Binary communication documentation for user to write a custom Intelligence Access program
	-37	RS232 Single Analyzer Communication, replaces RS485 loop communication
	-38	Reserved for future Fieldbus, replaces RS485
	-52	Back Lit Display, uniform green, P/N A9130023
	-70(x)	Extra instruction manuals, $ (EA)
	-72(x)	600 Interface Cable, P/N A9200006; specify length (x) @ $/ft.
	-89	Stainless Steel Tag

Sample Order:

654	-	6	Direct connected ORP analyzer

APPLICATION TIPS:

- ORP sensors are pH electrodes with a noble metal Tip (option -4) in place of the pH glass. Select from 600 series pH sensors
- ORP is lower impedance allowing electrode cables up to 1000 ft; consider cost over 100 ft. Use option -6
- Longer ORP loops generally include an interface to reduce noise. For lengths from 100-1000 ft. (or more), use 600 interface and cable, P/N A9200006

Appendix G: 600 Spec Sheet

INDUSTRIAL pH INTERFACE

Why buy from IC CONTROLS ?

You will get REAL SOLUTIONS to pH: reliable, accurate, long-life sensors, free application support and ongoing help with calibration and service. You get sensors designed to give you the best possible value for money expended. The result is reliable, continuous, accurate pH readings, even in dirty, hot, humid corrosive environments, and a commitment from the IC CONTROLS team to get you those results. You get access to our pH specialists "Free of Charge" who are generally chemists and/or chemical engineers that understand pH electrodes and how they interact with process liquids. Also "Free of Charge", you get access to our unique Application Development Laboratory. If you want help or better performance we will review your application and analyze any used pH sensor. This extra value added is then formulated into recommendations to improve your results, cut work needed, and costs.

Frequently new users have told us that they where referred to IC CONTROLS by staff at a related plant who where impressed by the extra value work done for them, the improved results and reduced workload achieved. They want to buy from IC CONTROLS too, to get that extra value for the day when they encounter problems.

IC CONTROLS does not just supply the pH electrodes and some backup tests. Our commitment to you includes the supplies to properly clean and calibrate your pH sensors, and continues until you are satisfied with the results, and beyond. In short, you get REAL SOLUTIONS to pH. IC CONTROLS developed calibration and cleaning procedures for continuous measurement pH systems. We manufacture and package standards, buffers, and supplies (with instructions) in convenient usage quantities. An IC CONTROLS pH sensor user in need of assistance with calibration techniques or any other matter is only a phone call away from our Application Development Laboratory specialists for advice and/or laboratory simulation of your problem. Buy from IC CONTROLS because you know the accuracy of your readings are as good as the quality of your calibrations, and you want the best results.

In short, buy from IC CONTROLS because you want to make your life easier, plus maintain or improve your pH results, but not increase costs. You want REAL SOLUTIONS to pH, value for your money!

FOR RELIABLE MEASUREMENT

- Strengthens weak pH electrode signal and makes it stable
- Minimizes moisture and interference problems
- Versions available for use with any make of analyzer
-

BENEFITS

- Eliminates need for desiccants
- Reduces electrical interference problems
- Normally supplied in weatherproof/explosion proof UL and CSA approved junction box
- Interfaces any electrode set to any analyzer (user specifies make & model of analyzer)
- Wiring and hook-up instructions for analyzer specified are included
- IC CONTROLS factory certified performance
-

History has shown that pH electrode signals can easily be disturbed because the electrode puts out a very tiny signal. Use of an industrial pH interface strengthens the signal so it has a reasonable chance of remaining stable in a plant environment. pH electrodes have a very high impedance which makes their leads a good antenna that easily picks up electrical noise in a plant. Long leads are long antennas and often result in unstable pH readings. A 600 pH interface gets rid of the problem and connections can be extended to thousands of feet. Moisture, dust and fingerprints can also short the very tiny pH signal; however, with a 600 pH interface they cannot.

Model 600

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

	BASIC DESCRIPTION (for use with IC CONTROLS 655 Analyzer)
MODEL 600	pH interface with preamplifier and terminations to minimize moisture and interference problems and provide field disconnect point for IC CONTROLS pH sensor with IC CONTROLS MICROPROCESSOR analyzer. Includes wiring instructions and weatherproof/explosion proof UL & CSA J-Box. Mounts on ¾" FNPT on top of pH sensor support ¾" pipe (for optional surface type J-Box add option -71). Required when Electrode is more than 100 feet from analyzer.

ADD	*WIRING AND PREAMP FOR USE WITH OTHER MANUFACTURERS' ANALYZERS*
-1(xx)	Rosemount (Uniloc) 1002, 1003, 1054, 1181, 2081 analyzers (analyzer model number in brackets)*
-2(xx)	Great Lakes A70, 60/65, PA77, 672P, 692P analyzers (analyzer model number brackets)*
-3(xx)	IC CONTROLS 652 & analog style, ECD UT21analyzers (analyzer model number in brackets)*
-4(xx)	L&N (Honeywell) 7073, 7075, 7082, 7079-11 analyzers (analyzer model number in brackets)*
-5(xx)	Beckman 940/960 analyzers; Rosemount/Beckman Solucomp SCL (analyzer model number in brackets)*
-6(xx)	Special 600 with battery power for direct connect analyzers* (allows long electrode separation)
-8(xx)	Bailey TBI 600 series analyzers (analyzer model number in brackets)*
-9(xx)	Others makes; Yokagowa, ABB, etc. (analyzer model number in brackets)*
-10(xx)	Foxboro 870 & 872 analyzers (analyzer model number in brackets)*

ADD	*OPTIONS*
-70(x)	Extra copies of intruction sheet (x). Priced quantity (x) times $ each.
-71	Weatherproof surface mounted J-Box, corrosion resistant plastic (not explosion proof)
-72(x)	Cable, preamp to IC microprocessor analyzer, P/N A9200006. Specify length (x) times $/ft.
-89	Stainless steel tag
-99	Special

* If required Analyzer Model is not shown above, an Interface may be manufactured if you provide Analyzer Instruction Manual, Wiring & Schematic Diagrams, and Service Information.

Sample Order:

600	-72(40')	An interface for IC CONTROLS analyzer with 40 ft. cable

Recommendations:

1. Recommended for all pH installations where electrode is more than 25 ft. from analyzer
2. Should be sold with pH cable, option -79(x), for run from 600 to pH analyzer.
3. For IC CONTROLS analog analyzers pHC01, pHC51, pHT20, specify P/N A9200000 pH cable (cable to connect between interface and analyzer)
4. 656 requires TWO (2) 600 interfaces, one for each pH electrode.

Note: Many existing installations can accept IC CONTROLS pH Electrodes directly connected to the existing (other) make of analyzer.

Appendix H: 602 Spec Sheet

LIGHT INDUSTRIAL pH SENSOR

"The Survivor"

Why buy from IC CONTROLS ?

You will get REAL SOLUTIONS to pH: reliable, accurate, long-life sensors, free application support and ongoing help with calibration and service. You get sensors designed to give you the best possible value for money expended. The result is reliable, continuous, accurate pH readings, even in dirty, hot, humid corrosive environments, and a commitment from the IC CONTROLS team to get you those results. You get access to our pH specialists "Free of Charge" who are generally chemists and/or chemical engineers that understand pH electrodes and how they interact with process liquids. Also "Free of Charge", you get access to our unique Application Development Laboratory. If you want help or better performance we will review your application and analyze any used pH sensor. This extra value added is then formulated into recommendations to improve your results, cut work needed, and costs.

Frequently new users have told us that they where referred to IC CONTROLS by staff at a related plant who where impressed by the extra value work done for them, the improved results and reduced workload achieved. They want to buy from IC CONTROLS too, to get that extra value for the day when they encounter problems.

IC CONTROLS does not just supply the pH electrodes and some backup tests. Our commitment to you includes the supplies to properly clean and calibrate your pH sensors, and continues until you are satisfied with the results, and beyond. In short, you get REAL SOLUTIONS to pH. IC CONTROLS developed calibration and cleaning procedures for continuous measurement pH systems. We manufacture and package standards, buffers, and supplies (with instructions) in convenient usage quantities. An IC CONTROLS pH sensor user in need of assistance with calibration techniques or any other matter is only a phone call away from our Application Development Laboratory specialists for advice and/or laboratory simulation of your problem. Buy from IC CONTROLS because you know the accuracy of your readings are as good as the quality of your calibrations, and you want the best results.

In short, buy from IC CONTROLS because you want to make your life easier, plus maintain or improve your pH results, but not increase costs. You want REAL SOLUTIONS to pH, value for your money!

BENEFITS

- Plant, Process or Laboratory use.
- Industrial process grab sampling.
- Durable, fast, accurate general purpose pH in a rugged PVC body.
- Continuous Light Industrial Applications
- Complete encapsulated design allows total submersion.
- Large reference junction (1.5 cm dia.) for reliable operation in most dirty environments.
- Shock mounted pH electrode for greater impact and handling survivability.
- Large reference capacity for long operating life.
- Optional Solid Plasticized reference and Double Junction slows ion flow for difficult applications, containing ammonia, chloride or sulfide ions.
- Use with any make of pH meter.

The 602 pH sensor is constructed from PVC, with the electrode fully encapsulated for outstanding reliability on submersion applications. It mounts on a 3/4" NPT thread in the end of a 1" support pipe, or can be suspended from it's lead. IC CONTROLS unique "cushion mounted" pH electrode design is used with a large, plug resistant, two stage junction to give fast response and long life.

With constantly fluctuating temperature, pressure, and poisoning ions specify the 602-7-8 optional, plasticized solid reference internal that resists these effects.

The 602 is compatible with many existing installations, fitting and analyzers.

Model 602

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL 602	*BASIC DESCRIPTION (Economical General Purpose Submersion pH Sensor)*	
	Rugged submersible/insertion combination pH electrode with protected general purpose 0 to 12 pH tip, wood reference junction, body material CPVC, 0-90°C (32-194°F), ¾" MNPT mounting threads, lead length 5ft. with BNC. Completely encapsulated. For sumbersion or flow installations.	
	ADD	*ELECTRODE OPTIONS (to change from General Purpose electrode)*
	-1	Ruggedized High Temperature pH Tip, 20-105°C (68-221°F), not recommended below 50°C (122°F)
	-3	High pH tip, for applications where 10 to 14 pH is common, 10-105°C (50-221°F)
	-4( )	-4(P): Platinum ORP Tip, -4(G) Gold ORP Tip
	-5	Extra rugged Tip, 20-130°C (68-266°F), 0-12 pH. Over 100°C (212°F) requires -8 & -12; expect 1-4 wks life
	-6	Flat Glass Tip, 0-90°C (32-194°F), 0-12 pH. Recommended for easy cleaning and minimum breakage.
	-7	Double-junction Reference, recommended for contaminating ions in the process
	-8	Plastic Reference, recommended for long life & hot applications
	-12	PVDF body, maximum 130°C (266°F). Limited by pH glass tip maximum temperature
	-17	Hytec II porous junction
	ADD	*OPTIONS*
	-19	Tip threaded for insertion ¾" MNPT, 1.1" insertion [-19(Sxx) other insertion lengths, price C.F.]
	-20	Removable tee type flow fitting, ¾" FNPT
	-31	Temperature compensator, 3K ohm (for 652 analyzer); separate unit -31S
	-32	Temperature compensator, 100 ohm RTD; separate unit- 32S
	-33	Temperature compensator for 655 MICROPROCESSOR [for pin jacks add (P)]; separate unit - 33S
	-34	Temperature compensator, 1000 ohm RTD; separate unit -34S
	-70(x)	Extra copies of instruction sheet
	-71(x)	Short cable: (x)ft, maximum of 4ft.
	-72(x)	Long cable: (x)ft, minimum 10ft. & maximum of 100ft. Priced length (x) times $/ft.
	-73	Pulp Modified Tip, flush surface
	-77	Anti-Coating Treatment
	-89	Stainless steel tag
	-93	Colored buffer 6-pack: 4, 7, & 10, P/N A1100054. For Pure Water see A1100220-6P
	-94	Buffer 4.0 pH, 500 mL bottle, red, P/N A1100051. For Pure Water see P/N A1100216
	-95	Buffer 7.0 pH, 500 mL bottle, green, P/N A1100052. For Pure Water see P/N A1100217
	-96	Buffer 10.0 pH, 500 mL bottle, blue, P/N A1100053. For Pure Water see P/N A1100218

Sample Order:

602	-19-20	Electrode in flow configuration

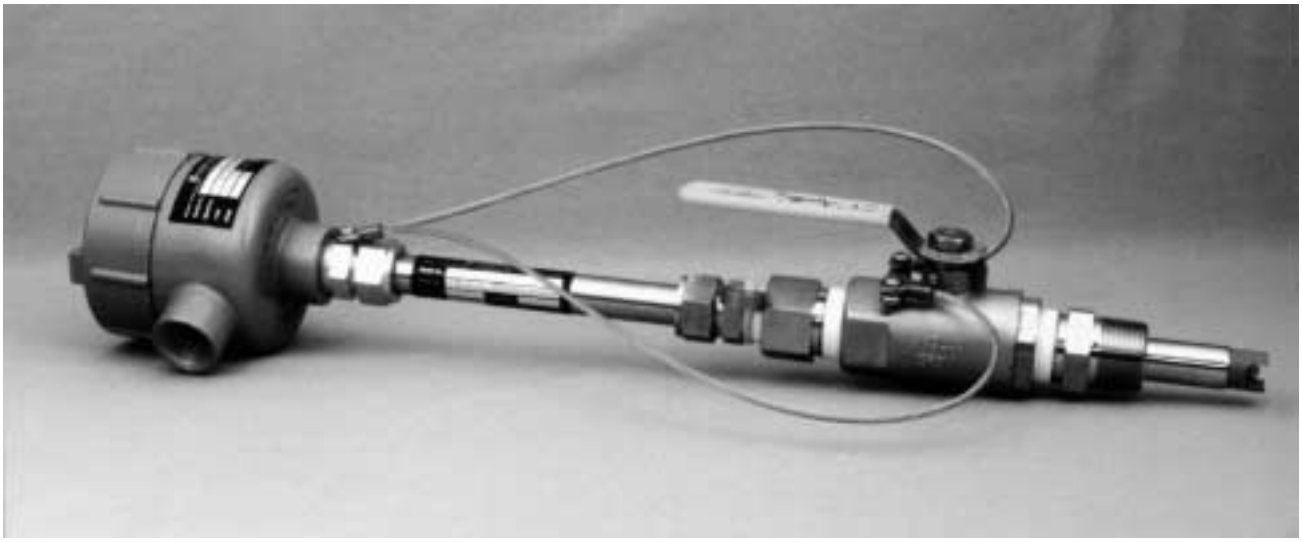
RECOMMENDATION FOR CALIBRATION AND SERVICE SUPPLIES:

Minimum: Color coded 4, 7 & 10 buffers. (option -93)

Normally: pH service kit, P/N A1600050
- 1 year calibration supply: 3 color-coded buffers (4 red, 7 green, 10 blue) in 6-packs.
- electrode washing solution, P/N A1100091
- four 250 mL plastic beakers, P/N A1100020
- 1 squeeze bottle, P/N A1100014
- 6-pack of 500 mL bottles deionized water, P/N A1100192-6P

Appendix I: 605 Spec Sheet

SS BODY or BALL VALVE INDUSTRIAL SENSOR



The IC Controls Model 605 was designed to provide reliable pH measurement in demanding applications where pressure cannot be reduced to zero for electrode removal.

It meets the requirement for a ball valve insertion electrode for pulp & paper stock lines and other difficult applications.

Small Cross Section steel housing with epoxy encapsulated electrode better survives the rigors of direct insertion into dense stock and the bending forces that can cause breakage or insertion / removal problems associated with large diameter sensor styles.

This sensor was initially requested as a replaceable cartridge style. However, cartridges experienced drifting and premature failure due to moisture reaching the BNC fitting on the back of the electrode cartridge. The Model 605 single-piece epoxy encapsulated electrode eliminates the problem and provides long, trouble free operating life.

FOR RELIABLE MEASUREMENT WHERE TOUGH PROCESSES REQUIRE

- The strength of steel at only .75 inch diameter
- Sealed disposable design
- A solution ground
- Ball valve retraction for no process interruption during calibration or service

BENEFITS

- Sealed self-pressurizing design
- Stainless steel body
- Body options – titanium and PVDF
- Stable circular reference
- Low maintenance
- Easy calibration
- Automatic temperature compensation available
- IC CONTROLS factory certified calibration

Model 605

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL 605	*BASIC DESCRIPTION (Rugged SS Housed Ball Valve Retractable General Purpose pH Sensor)*	Industrial 0-12 pH sensor constructed of rugged 316 SS material, ¾" diameter body, 6.5" long with a 5 ft. cable. Mounting ¾" MNPT, maximum pressure 150 PSIG, maximum temperature 100°C (212°F). The pH electrode is sealed in a SS body. Reference is solid plastic with long life porous plastic annular Junction. Optional temperature compensation available. Includes one instruction manual. Requires preamp interface, option -22 or Model 600-71.

ADD	ELECTRODE OPTIONS (to change from General Purpose electrode)
-0	Solution ground connected
-1	Ruggedized high temperature 20-105°C (68-221°F), not recommended below 50°C (122°F), requires -11
-2	Low temperature -5 to 80°C (23-176°F), recommended for -5 to 10°C (23-50°F) applications
-3	High pH for applications where 10 to 14 pH is common
-4(x)	-4(P): Platinum ORP tip, -4(G): Gold ORP tip
-5	Extra Rugged tip, 20-130°C (68-266°F), 0 to 12 pH; over 105°C (221°F) requires -14 & -73, expect 1-4 wks life
-6	Flat Glass tip, 0-90°C (32-194°F), 0 to 12 pH
-7	Double junction reference, recommended for contaminating ions in the process
-8	Wood reference junction
-9	Pulp tip configuration with recessed flush glass

ADD	BODY OPTIONS (to change material or length for retractable)
-11	16.5" SS body length for ball valve retraction (12" cable)
-12	12" body length
-13	Titanium body 6.5" length; for ball valve retractable length add -11
-14	PVDF wetted electrode insulator (standard is CPVC)
-15	Hasteloy C, 16.5" long body
-17	Hytec II porous junction
-19(x)	Extra long body (x) inch for thick walls & ball valve retraction (12" cable), $ per inch
-21	Retractable, ball valve (max. 100 PSIG), 1" MNPT, fittings, safety lanyards, etc., P/N A2100052, requires -11
-22	Integral mounted 600 interface in explosion proof UL & CSA J-box
-23	Titanium ball valve retractable (max 100 PSIG): ball valve, fittings, etc. Requires -11 -13, P/N A2100055
-24	SS dense stock flush fittings for -21, P/N A3100062
-25	Titanium dense stock flush fittings for -26, P/N A3100126
-26	PVDF ball valve & dense stock flush titanium fittings, P/N A2100054 (alternative to option -23)
-27	Hasteloy C ball valve retractable: ball valve, fittings, etc. Requires -11 -15, P/N A2100056
-28	Hasteloy C dense stock flush fittings for -27, P/N A3100228

ADD	TEMPERATURE COMPENSATION OPTIONS
-31	Temperature compensator, 3K ohm (for 652 Analyzer); for pin jacks add (P)
-32	Temperature compensator, 100 ohm RTD; for pin jack add (P)
-33	Temperature compensator for 655 MICROPROCESSOR; for pin jacks add (P)
-34	Temperature compensator, 1000 ohm RTD; for pin jacks add (P)

ADD	OPTIONS
-70(x)	Extra copies of instruction manual (x), qty required $ (EA)
-71(x)	Short cable (x) feet: minimum 6", maximum 66"
-72(x)	Long cable (x) feet: minimum 6 ft., maximum 100 ft. Priced length (x) times $/ft.
-73	High temperature construction 105-130°C (221-266°F) maximum
-74	Stainless steel insertion gland fitting ¾" MNPT, P/N A3100002
-75	Titanium insertion gland fitting, ¾" NPT, P/N A3100003
-76	Hasteloy C insertion gland fitting, ¾" NPT, P/N A3100212
-77	Anti-Coating Treatment
-89	Stainless steel tag
-93	Coloured Buffer 6-pack: pH 4, 7 & 10, P/N A1100054. For Pure Water, P/N A1100220-6P
-94	Buffer 4.0 pH, 500 mL bottle, red, P/N A1100051. For Pure Water see P/N A1100216
-95	Buffer 7.0 pH, 500 mL bottle, green, P/N A1100052. For Pure Water see P/N A1100217
-96	Buffer 10.0 pH, 500 mL bottle, blue, P/N A1100053. For Pure Water see P/N A1100218
-98	pH Service Kit, 1 year supply, P/N A1600050
-99	Special

Sample Order:

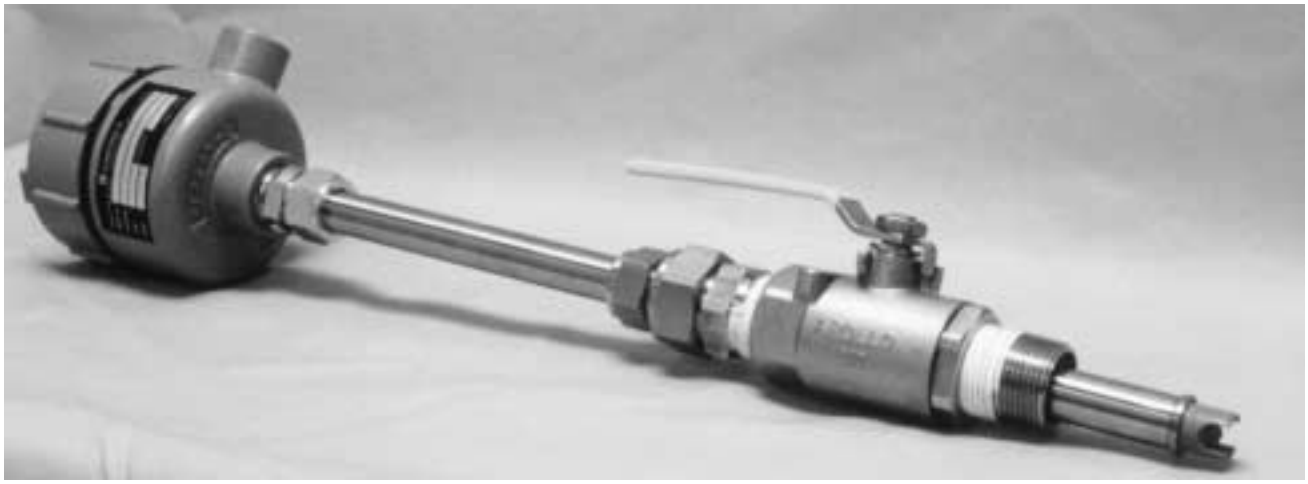
605	-1-7-9	-11-21-22	-24	-33	-93	Ball valve type, for hot dense pulp stock pH, with flush fittings
605	-1-7-9	-11		-33	-71(6")	Replacement pH sensor for above

RECOMMENDATION FOR CALIBRATION AND SERVICE SUPPLIES:

Minimum Color coded pH 4, 7 & 10 buffers (option -93)
Normally: pH service kit, P/N A1600050 (option -98)

Appendix J: 606 Spec Sheet

BALL VALVE RETRACTABLE INDUSTRIAL SENSOR



The IC Controls Model 606 was designed to provide reliable pH measurement in demanding applications where pressure cannot be reduced to zero for electrode removal. IC Controls 605 and 617 also can handle the service. However, for safety reasons, some users prefer a positive anti blowout lip that cannot pass through the insertion gland. The 606 provides that lip and optional safety lanyards for the ultimate double-safe design.

It meets the requirement for a ball valve insertion electrode for pulp & paper stock lines and other difficult applications.

The Small Cross Section steel housing with epoxy encapsulated electrode survives the rigors of direct insertion into dense stock and the bending forces that can cause breakage or insertion / removal problems associated with large diameter sensor styles.

This sensor was initially requested as a replaceable cartridge style. However, cartridges are prone to drift and premature failure due to moisture reaching the BNC fitting on the back of the electrode cartridge. The Model 606 single-piece epoxy encapsulated electrode eliminates the problem and provides long, trouble free operating life.

FOR MAXIMUM SAFETY IN TOUGH PROCESSES

- The strength of .75 inch diameter SS
- Stainless steel lip preventing blowout

BENEFITS

- Ball valve retraction eliminates process interruption during calibration or service
- Sealed leak free self-pressurizing design
- Shock-mounted pH electrode for greater impact and handling survivability
- Stable circular reference
- Low maintenance plasticized reference slows ion flow for long life in difficult applications
- Easy calibration
- Stainless steel body
- Body options – Titanium, Hasteloy C
- Automatic temperature compensation available
- IC CONTROLS factory certified calibration

Model 606

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL	*BASIC DESCRIPTION (Rugged SS Housed Ball Valve Retractable General Purpose pH Sensor)*
606	Industrial 0-12 pH sensor constructed of rugged 316 SS material with, ¾" diameter body with anti blowout lip, 16.5" long with a 5 ft. cable. Mounts in ball valve assembly 1" MNPT, maximum pressure 150 PSIG, maximum temperature 100°C (212°F). The pH electrode is sealed in a SS body. Reference is solid plastic with long life porous plastic annular Junction. Optional temperature compensation available. Includes one instruction manual. Requires preamp interface, option -22 or Model 600-71.

ADD	*ELECTRODE OPTIONS (to change from General Purpose electrode)*
-0	Solution ground connected
-1	Ruggedized high temperature 20-105°C (68-221°F), not recommended below 50°C (122°F), requires -11
-2	Low temperature -5 to 80°C (23-176°F), recommended for -5 to 10°C (23-50°F) applications
-3	High pH for applications where 10 to 14 pH is common
-4(x)	-4(P): Platinum ORP tip, -4(G): Gold ORP tip
-5	Extra Rugged tip, 20-130°C (68-266°F), 0 to 12 pH; over 105°C (221°F) requires -14 & -73, expect 1-4 wks life
-6	Flat Glass tip, 0-90°C (32-194°F), 0 to 12 pH
-7	Double junction reference, recommended for contaminating ions in the process
-8	Wood reference junction
-9	Pulp tip configuration with recessed flush glass

ADD	*BODY OPTIONS (to change material or length for retractable)*
-12	12" body length
-13	Titanium body 16.5" length
-14	PVDF wetted electrode insulator (standard is CPVC)
-15	Hasteloy C, 16.5" long body
-17	Hytec II porous junction
-19(x)	Extra long body (x) for thick walls, (x)-17 x $ per extra inch
-20	Lanyard set from 605, second safety stop, retains electrode tube if gland nut released, P/N A1100011
-21	Retractable, ball valve (max. 100 PSIG), 1" MNPT, fittings, etc., P/N A2100071
-22	Integral mounted 600 interface in explosion proof UL & CSA J-box, requires -71(12") Short cable 12" long
-23	Titanium ball valve retractable (max 100 PSIG): ball valve, fittings, etc. Requires -11 -13, P/N A2100072
-24	SS dense stock flush fittings for -21, P/N A3100241
-25	Titanium dense stock flush fittings for -26, P/N A3100242
-26	PVDF ball valve & dense stock flush titanium fittings, P/N A2100073 (alternative to option -23)
-27	Hasteloy C ball valve retractable: ball valve, fittings, etc. Requires -11 -15, P/N A2100074
-28	Hasteloy C dense stock flush fittings for -27, P/N A3100243

ADD	*TEMPERATURE COMPENSATION OPTIONS*
-31	Temperature compensator, 3K ohm (for 652 Analyzer); for pin jacks add (P)
-32	Temperature compensator, 100 ohm RTD; for pin jack add (P)
-33	Temperature compensator for 655 MICROPROCESSOR; for pin jacks add (P)
-34	Temperature compensator, 1000 ohm RTD; for pin jacks add (P)

ADD	*OPTIONS*
-70(x)	Extra copies of instruction manual (x), qty required $ (EA)
-71(x)	Short cable (x) feet: minimum 6", maximum 66"
-72(x)	Long cable (x) feet: minimum 6 ft., maximum 100 ft. Priced length (x) times $/ft.
-73	High temperature construction 105-130°C (221-266°F) maximum
-77	Anti-Coating Treatment
-89	Stainless steel tag
-93	Coloured Buffer 6-pack: pH 4, 7 & 10, P/N A1100054. For Pure Water, P/N A1100220-6P
-94	Buffer 4.0 pH, 500 mL bottle, red, P/N A1100051. For Pure Water see P/N A1100216
-95	Buffer 7.0 pH, 500 mL bottle, green, P/N A1100052. For Pure Water see P/N A1100217
-96	Buffer 10.0 pH, 500 mL bottle, blue, P/N A1100053. For Pure Water see P/N A1100218
-98	pH Service Kit, 1 year supply, P/N A1600050
-99	Special

Sample Order:

606	-1-7-9	-21-22	-24	-33	-93	Ball valve type, for hot dense pulp stock pH, with flush fittings
606	-1-7-9	-		-33	-71(12")	Replacement pH sensor for above

RECOMMENDATION FOR CALIBRATION AND SERVICE SUPPLIES:

Minimum Color coded pH 4, 7 & 10 buffers (option -93)
Normally: pH service kit, P/N A1600050 (option -98)

Appendix K: 607 Spec Sheet

CARTRIDGE pH ELECTRODE

Why buy from IC CONTROLS ?

You will get REAL SOLUTIONS to pH: reliable, accurate, long-life sensors, free application support and ongoing help with calibration and service. You get sensors designed to give you the best possible value for money expended. The result is reliable, continuous, accurate pH readings, even in dirty, hot, humid corrosive environments, and a commitment from the IC CONTROLS team to get you those results. You get access to our pH specialists "Free of Charge" who are generally chemists and/or chemical engineers that understand pH electrodes and how they interact with process liquids. Also "Free of Charge", you get access to our unique Application Development Laboratory. If you want help or better performance we will review your application and analyze any used pH sensor. This extra value added is then formulated into recommendations to improve your results, cut work needed, and costs.

Frequently new users have told us that they where referred to IC CONTROLS by staff at a related plant who where impressed by the extra value work done for them, the improved results and reduced workload achieved. They want to buy from IC CONTROLS too, to get that extra value for the day when they encounter problems.

IC CONTROLS does not just supply the pH electrodes and some backup tests. Our commitment to you includes the supplies to properly clean and calibrate your pH sensors, and continues until you are satisfied with the results, and beyond. In short, you get REAL SOLUTIONS to pH. IC CONTROLS developed calibration and cleaning procedures for continuous measurement pH systems. We manufacture and package standards, buffers, and supplies (with instructions) in convenient usage quantities. An IC CONTROLS pH sensor user in need of assistance with calibration techniques or any other matter is only a phone call away from our Application Development Laboratory specialists for advice and/or laboratory simulation of your problem. Buy from IC CONTROLS because you know the accuracy of your readings are as good as the quality of your calibrations, and you want the best results.

In short, buy from IC CONTROLS because you want to make your life easier, plus maintain or improve your pH results, but not increase costs. You want REAL SOLUTIONS to pH, value for your money!

BENEFITS

- Disassembles - replace pH sensor and re-use titanium or 316 SS body and fittings.
- Large reference junction (2 cm dia.) assures reliable operation in most dirty environments.
- Shock mounted pH electrode for greater impact and handling survivability.
- Larger reference capacity for longer operating life.
- Plasticized reference slows ion flow for difficult applications.

The 607 replaceable pH cartridge is constructed from 3/4" sch. 80 PVDF pipe, with the electrode assembly fully encapsulated for outstanding reliability and economy on applications to 90°C. This replaceable sensor element fits inside the 316 SS or titanium 17" body.

The IC CONTROLS Model 607 uses a unique plasticized Ag/AgCl reference half cell featuring a large internal cavity with approximately 100 times the volume for longer life in routine applications. In addition, IC CONTROLS unique "cushion mounted " pH electrode design is used. A large, plug resistant, two-stage junction gives fast response and long life.

For applications with constantly fluctuating temperature, pressure, and poisoning ions, the 607 with its plasticized reference internal gives you a solid reference which resists these effects.

The 607 is compatible with many existing installation fittings and electrode body configurations.

Model 607

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL	*BASIC DESCRIPTION (Cartridge Type General Purpose pH Sensor)*
607	Industrial process cartridge 0-12 pH electrode constructed of PVDF material, body fits 1" sheath, 6.5" long with a 6 ft. cable. Maximum pressure 100 PSIG, maximum temperature 100°C (212°F). The pH electrode is designed to be mounted in a 1" stainless steel body. Reference is plastic with porous plastic annular junction for long life. Optional temperature compensation available. Includes one instruction manual. Recommended option -22 or 600 preamp interface.

ADD	*ELECTRODE OPTIONS (to change from General Purpose electrode)*
-0	Solution ground connected
-1	Ruggedized high temperature tip 20-105°C (68-221°F), not recommended below 50°C (122°F)
-2	Low temperature -5 to 80°C (23-176°F), recommended for -5 to 10°C (23-50°F) applications
-3	High pH tip 20-120°C (68-248°F), recommended where 10 to 14 pH is common, or hot caustic
-4(x)	ORP sensor: -4(P): Platinum ORP tip, -4(G): Gold ORP tip
-5	Extra rugged tip, 20-130°C (68-266°F), 0 to 12 pH; over 105°C (221°F) requires -73, expect 1-4 wks life
-6	Flat Glass tip, 0-90°C (32-194°F), 0 to 12 pH
-7	Double junction internal reference, recommended for contaminating ions in the process
-8	Wood reference junction
-9	Pulp tip configuration with recessed flush glass

ADD	*BODY OPTIONS (to change material or length for retractable)*
-10	6.5" SS body (8" assy length) for direct insertion, with electrode holder. Requires -74 or -75
-11	15" SS body (17" assy length) for ball valve retraction, with electrode retainer and coupling
-12(x)	Long body with length specified (x) inches; $ per inch
-13	Titanium body, 15" body (has 17" assy length)
-14	24" leads for integral interface
-21	SS Ball valve retractable (maximum 100 PSIG), includes ball valve, fitting, etc., requires -11
-22	Integral mounted 600 interface in explosion proof UL & CSA J-box, requires -14
-23	Titanium ball valve retractable (maximum100 PSIG), includes ball valve, fittings etc., requires -13

ADD	*TEMPERATURE COMPENSATION OPTIONS*
-31	Temperature compensator, 3K ohm (for 652); for pin jacks add (P), for MOEX connector add (MC)
-32	Temperature compensator, 100 ohm RTD; for pin jacks add (P)
-33	Temperature compensator for 655 MICROPROCESSOR;for pin jacks add (P)]
-34	Temperature compensator, 1000 ohm RTD; for pin jacks add (P)

ADD	*OPTIONS*
-70(x)	Extra copies of instruction manual (x), qty required $ (EA)
-71(x)	Short pH electrode cable; minimum 24", maximum 71"
-72(x)	Long pH electrode cable; minimum 6 ft., maximum 100 ft. Priced length times $/ft.
-73	High temp. construction 105-130°C (221-266°F)
-74	Stainless steel gland fitting, 1" MNPT, P/N A3100175
-75	Titanium gland fitting, 1" MNPT, P/N A3100095
-77	Anti-Coating Treatment
-89	Stainless steel tag
-93	Buffer 6-pack: pH 4, 7 & 10, P/N A1100054. For Pure Water see P/N A1100220-6P
-94	Buffer 4.0 pH, 500 mL, red, P/N A1100051. For Pure Water see P/N A1100216
-95	Buffer 7.0 pH, 500 mL, green, P/N A1100052. For Pure Water see P/N A1100217
-96	Buffer 10.0 pH, 500 mL, blue, P/N A1100053. For Pure Water see P/N A1100218
-98	pH Service Kit: 1 year supply, P/N A1600050
-99	Special

Sample Order:

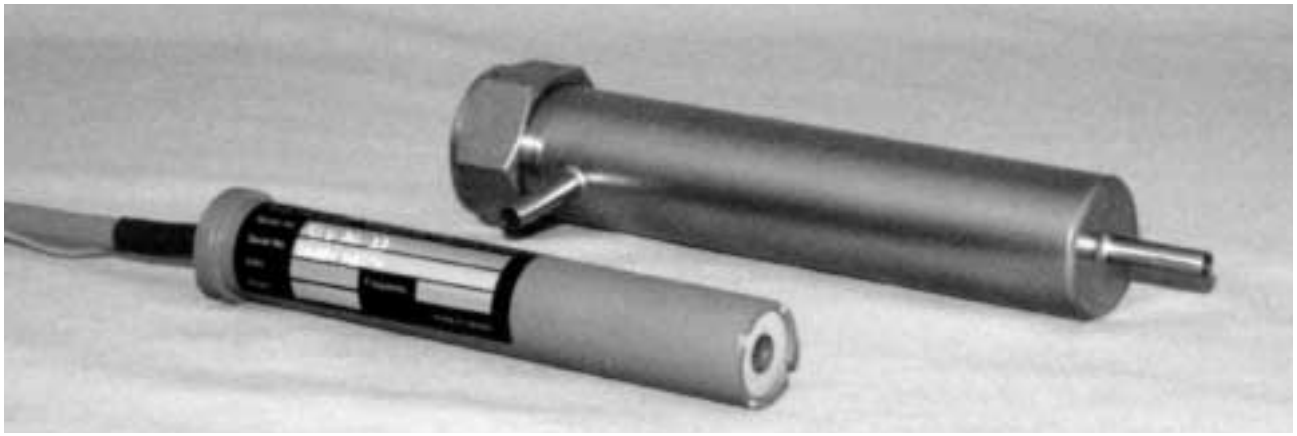
607	-1-9-11	-14-21-22	-33	-93	Ball valve retractable, pulp line pH with preamp & calibration kit
607	-1-9	-14	-33	-	Replacement pH electrode for above

RECOMMENDATION FOR CALIBRATION AND SERVICE:

Minimum Color coded pH 4, 7 & 10 buffers (option -93)
Normal: pH service kit, P/N A1600050 (option -98)

Appendix L: 615 Spec Sheet

PURE WATER pH



Pure Water pH Measurement

Due to the lack of conductive ions in high purity water a number of interference's occur which show up as a drifting and spiked measurement that end up from the correct value. Without ions providing a conductive circuit the pH electrode, coupled to a modern ultra high impedance preamp, acts as a high gain, high efficiency antenna. Chloride ions escaping from the reference cell tend to partly short the antenna effect, causing the pH electrode to try and establish a new balance. When any changes in sample flow occur the rate at which these ions are swept away is upset, resulting in a compensating adjustment in the pH electrode. This is often described as sweeping away the "ion cloud". A related effect is the junction potential at the reference junction which is also influenced by the number of ions and the rate of sweeping away. As sample flow increases the actual conductivity produced by the ions drops due to fewer ions left in the junction area. The junction, like a thermocouple, puts out a millivoltage relative to the two dissimilar conductors it is composed of. This, of course, changes if one of the conductors (ion concentration) is changing.

See also the article "Pure Water pH Measurement in Low Conductivity Samples", in the Boiler Water section.

615 Benefits for Pure Water

Close spacing between electrode components sharply reduces high impedance and ion effects for stable pH readings. Small internals allow low-flow with fast pH response.

For reliable pH measurement of low conductivity boiler water and other low conductivity water.

- High Purity pH measurement recommended for conductivity of 15 micro Siemen to 1 micro Siemen
- Ultra Pure pH measurement recommended for conductivity of 5 micro Siemen to 0.055 micro Siemen (Resistivity 2 megohms to 18 megohms)
- Small flow applications—like pilot plants

BENEFITS

- Stainless steel total-surround shielding defeats antenna effect
- Large concentric reference assures stable ionic contact and stable readings
- Cell is driven by analyzer to produce electron rich environment for stable readings to 18 meg ohms (option -26)
- Design passes air and CO_2 bubbles
- Fast accurate response, even with varying flow
- Handles 100°C at up to 100 PSIG, -12 option up to 130°C
- High purity temperature compensation with IC CONTROLS 655 analyzer
- Economical, easily replaceable pH electrode

Model 615

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL	*BASIC DESCRIPTION (Low Conductivity Water pH electrode)*
615	High Purity Water 0-12 pH electrode constructed of CPVC material, body fits inside a 615 SS flowcell housing, comes with a 6 ft. double shielded cable. Maximum pressure 100 PSIG, maximum temperature 100°C (212°F). The pH electrode is completely shielded in the stainless steel flow body. Reference is plastic with porous plastic annular junction surrounding the pH glass ensuring stable ionic connection. Sample entering directly at the pH tip ensures fast response and no drift from pH shifts induced by KCl salt dissociation as concentration changes with sample flow. Small pH tip design also passes entrained air and CO2 bubbles. Includes one instruction manual. Recommended for new installations below 1 µSiemen, options -21, -26, and -24; below 15 µSiemen, options -21, -25, and -24.

ADD	*ELECTRODE OPTIONS (to change from General Purpose electrode)*
-5	Extra rugged tip, 20-105°C (68-221°F), 0-12 pH

ADD	*BODY OPTIONS (to change material or make packaged system)*
-21	615 SS flowcell assembly, sample inlet and outlet ¼" tube, P/N A2100059
-24	24" leads for integral interface
-25	Pure (<15 µSiemen) pH system with interface in NEMA 4X J-Box on a backplate, requires -24 & -21
-26	Ultra Pure (<1 µSiemen) pH system with interface in NEMA 4X J-Box on a backplate, requires -24 & -21
-27	655 analyzer in place of interface; requires -25 or -26, plus purchase 655 analyzer separately

ADD	*TEMPERATURE COMPENSATION OPTIONS*
-31	Temperature compensator, 3K ohm (for 652 Analyzer); for pin jacks add (P)
-32	Temperature compensator, 100 ohm RTD; for pin jacks add (P)
-33	Temperature compensator for 655 MICROPROCESSOR; for pin jacks add (P)
-34	Temperature compensator, 1000 ohm RTD; for pin jacks add (P)

ADD	*OPTIONS*
-70(x)	Extra copies of instruction manual (x), qty required $ (EA)
-71(x)	Short pH electrode cable; minimum 24", maximum 71"
-72(x)	Cable, preamp to IC microprocessor analyzer, P/N A9200006 ft(xx) times $/ft.
-73	High temperature construction, 105-130°C (221-266°F)
-77	Anti-Coating Treatment
-89	Stainless steel tag
-93	Buffer 6-pack: 4, 7 & 10 for Pure Water, P/N A1100220-6P & A1100219
-94	Buffer 4.0 pH, 500 mL for Pure Water, P/N A1100216
-95	Buffer 7.0 pH, 500 mL for Pure Water, P/N A1100217
-96	Buffer 10.0 pH, 500 mL, for Pure Water, P/N A1100218
-98	pH Calibration Kit for low conductivity water, P/N A1600053
-99	Special

Sample Order:

615	-	-21-24-25	-33	-98	High Purity pH sensor system with interface and Calibration Kit
615		-24	-33	-	Replacement pH electrode for above

RECOMMENDATION FOR CALIBRATION AND SERVICE:

Minimum: 6-Pack 4, 7 & 10 Low Conductivity buffers. (option -93)
Plus Spare 615-33 or 615-24-33 Electrode

Normally: pH Calibration Kit for Low Conductivity Water (option -98)

Appendix M: 617 Spec Sheet

High Pressure Retractable pH

Why buy from IC CONTROLS ?

You will get REAL SOLUTIONS to pH; reliable, accurate, long-life sensors, free application support and ongoing help with calibration and service. You get sensors designed to give you the best possible value for money expended. The result is reliable, continuous, accurate pH readings, even in dirty hot humid corrosive environments, and a commitment from the IC CONTROLS team to get you those results. You get access to our pH specialists "Free of Charge" who are generally chemists and/or chemical engineers that understand pH electrodes and how they interact with process liquids. Also "Free of Charge", you get access to our unique Application Development Laboratory. If you want help or better performance we will review your application and analyze any used pH sensor. This extra value added is then formulated into recommendations to improve your results, cut work needed, and costs.

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IC CONTROLS does not just supply the pH electrodes and some backup tests. Our commitment to you includes the supplies to properly clean and calibrate your pH sensors, and continues until you are satisfied with the results, and beyond. In short you get REAL SOLUTIONS to pH. IC CONTROLS developed calibration and cleaning procedures for continuous measurement pH systems. We manufacture and package standards, buffers, and supplies (with instructions) in convenient usage quantities. An IC CONTROLS pH sensor user in need of assistance with calibration techniques or any other matter, is only a phone call away from our Application Development Laboratory specialists for advise and/or laboratory simulation of your problem. Buy from IC CONTROLS because you know the accuracy of your readings are as good as the quality of your calibrations, and you want the best results.

In short buy from IC CONTROLS because you want to make your life easier, plus maintain or improve your pH results, but not increase costs. You want REAL SOLUTIONS to pH, value for your money!

BENEFITS

- Handles up to 300 PSIG; purges dirt, fiber or corrosives.
- Isolation chamber protects operators from corrosive or flashing process.
- Ball Valve retraction for no process interruption during calibrate or service.
- Disassembles - replace pH sensor and re-use titanium or 316 SS body and fittings.
- Large reference junction (2 cm dia.) assures reliable operation in most dirty environments.
- Shock-mounted pH electrode for greater impact and handling survivability.
- Larger reference capacity for longer operating life.
- Plasticized reference slows ion flow for difficult applications.

The 617 replaceable pH cartridge is constructed from PVDF, with the electrode fully encapsulated for outstanding reliability on applications to 300 PSIG. It fits on a threaded retraction rod to move through the ball valve in/out of the process isolation chamber.

Balanced pressure design reduces the forces necessary for insertion into high pressures. An explosion-proof preamp housing provides a large surface to push against the higher process pressure.

A unique plasticized Ag/AgCl reference half cell features a large internal cavity with approximately 100 times the volume and gives longer life in most applications. In addition, IC CONTROLS unique "cushion mounted" pH electrode design is used while a large, plug resistant, two-stage junction gives fast response and long life.

With constantly fluctuating temperature, pressure, and poisoning ions, the 617 with its plasticized reference internal gives you a solid reference which resists these effects.

The 617 is compatible with many existing installation fittings and electrode body configurations.

Model 617

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL 617	*BASIC DESCRIPTION (High Pressure Retractable pH Sensor)*				
	Industrial High Pressure 0-12 pH cartridge electrode, PVDF & SS, 7.25" long, fits 13/16-20 thread retractor, 6 ft. cable with mini-BNC. Maximum pressure 300 PSIG, temperature 105°C (221°F). pH electrode retracts into a 1.25" diameter process isolation housing. Reference is plastic with long life porous plastic annular junction. Optional temperature compensation available. Includes one instruction manual. Recommended option -22 or Model 600 preamp interface.				
	ADD	*ELECTRODE OPTIONS (to change from General Purpose electrode)*			
	-0	Solution ground connected			
	-3	Rugged HighTemperature/pH tip 20-120°C (68-248°F), recommended where 10-14 pH is common, or hot caustic			
	-4(x)	4(P): Platinum ORP tip, 4(G): Gold ORP tip			
	-5	Extra rugged tip, 20-130°C (68-266°F), 0-12 pH. Over 105°C (221°F) requires -73, expect 1-4 wks life			
	-6	Flat glass tip and junction, 0-95°C (32-203°F), 0-14 pH			
	-7	Double junction internal reference, recommended for contaminating ions in the process			
	-8	Wood reference junction			
	-9	Pulp tip configuration with recessed flush glass			
		ADD	*OPTIONS (to change material or add process isolation housing)*		
		-13	Titanium body pressure band		
		-14	24" leads for integral interface		
		-21	SS retractable (maximum 300 PSIG), all wetted parts SS, ball valve, fittings, housing, etc.		
		-22	Integral mounted 600 interface in explosion proof UL & CSA J-box, requires -14		
		-23	Titanium retractable (maximum 300 PSIG), all wetted parts TI, ball valve, fittings, housing, etc.		
			ADD	*TEMPERATURE COMPENSATION OPTIONS*	
			-31	Temperature compensator, 3K ohm (for 652 Analyzer); for pin jacks add (P)	
			-32	Temperature compensator, 100 ohm RTD; for pin jacks add (P)	
			-33	Temperature compensator for 655 MICROPROCESSOR; for pin jacks add (P)	
			-34	Temperature compensator, 1000 ohm RTD; for pin jacks add (P)	
				ADD	*OPTIONS*
				-70(x)	Extra copies of instruction manual (x), qty required $ (EA)
				-71(x)	Short cable; minimum 24", maximum 71"
				-72(x)	Long cable; minimum 6ft., maximum 100 ft., $/ft.
				-73	High temp. construction 105-130°C (221-266°F), PVDF ins, etc.
				-74	Adapter fitting, mini-BNC to BNC, for use with BNC preamp, P/N A2500059
				-77	Anti-Coating Treatment
				-89	Stainless steel tag
				-93	Buffer 6-pack: 4, 7 & 10, P/N A1100054. For Pure Water see P/N A1100220-6P
				-94	Buffer 4.0 pH, 500 mL, red, P/N A1100051. For Pure Water see P/N A1100216
				-95	Buffer 7.0 pH, 500 mL, green, P/N A1100052. For Pure Water see P/N A1100217
				-96	Buffer 10.0 pH, 500 mL, blue, P/N A1100053. For Pure Water see P/N A1100218
				-98	pH Service Kit: 1 year supply, P/N A1600050
				-99	Special

Sample Order:

617	-3-9	-14-21-22	-33	-74-93	Ball valve retractable, high pressure pulp line pH sensor with preamp, adapter & cal. kit
617	-3-9	-14	-33	-	Replacement pH electrode for above sensor assembly

RECOMMENDATION FOR CALIBRATION AND SERVICE:

Minimum: Color coded 4, 7 & 10 buffers. (option -93)

Normal: pH service kit P/N A1600050
Adapter, mini-BNC to BNC, P/N A2500059

Appendix N: 625 Spec Sheet

QUICK UNION ELECTRODE

The Model 625 Quick Union pH Electrode is a universal version offered in an easy to install configuration for insertion or submersion applications. The Union style threaded fitting locks in the electrode for extra safety and very easy removal.

Recommended for applications where frequent removal in tough applications for calibration, cleaning or Q.C. checks is required.

FOR UNIVERSAL USE

- Submersion, Insertion, or Flow
- Environmental Monitoring
- Process liquids

BENEFITS

- Only one sensor needed for all uses
- Easy to lock in or remove for calibration
- Hand size body for easy grip
- Rugged body constructed from 1" Schedule 80 pipe
- Cushion mounted pH electrode resists shocks
- "U" shaped body protects glass tip from breakage during calibration, cleaning and accidental impact
- Open electrode tip for easy cleaning
- Large 1" diameter reference junction surrounding pH tip resists plugging and eliminates variation in reading caused by changes in flow direction
- Low maintenance, easy to calibrate
- Rapid and accurate response
- Quick Union design for submersion, screw-in, and flow-through applications all with one interchangeable sensor
- Recommended where labor costs of frequent removal (Q.C. checks, etc.) make added sensor costs economical.

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In short, buy from IC CONTROLS because you want to make your life easier, plus maintain or improve your pH results, but not increase costs. You want REAL SOLUTIONS to pH, value for your money!

Model 625

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL	BASIC DESCRIPTION (Quick Connect Union General Purpose pH Sensor)
625	Universal industrial, union type, submersible, combination pH electrode with protected general-purpose tip for 0-12 pH & 10-80°C (50-176°F) at 0-60 PSIG, annular wood junction reference, sealed self-pressurizing design. 8" CPVC body, Quick Union process connections (1½" MNPT fitting) & ¾" FNPT submersion mounting, lead 5 ft., fitting BNC. Includes one instruction manual.

ADD	pH ELECTRODE OPTIONS (to change from General Purpose electrode)
-0	Solution ground connected
-1	Ruggedized high temperature 20-105°C (68-221°F), not recommended below 50°C (122°F)
-2	Low temperature -5 to 80°C (23-176°F), recommended for -5 to 10°C (23-50°F) applications
-3	High pH tip 20-120°C (68-248°F), 0-14 pH recommended where 10-14 pH is common or hot caustic
-4(x)	-4(P): Platinum ORP tip; -4(G): Gold ORP tip
-5	Extra-rugged tip, 20-130°C, 0-12 pH, requires -13, -29 & -28 or -30. Over 105°C (221°F) expect 1-4 wks life
-6	Flat Glass tip, 0-50°C (32-122°F), 0-12 pH
-7	Double-junction electrode, recommended for contaminating ions in the process
-8	Plastic reference, recommended to retard ion depleting and on all applications over 80°C (176°F)

ADD	BODY & JUNCTION OPTIONS
-13	PVDF body for 130°C (266°F) maximum, requires -27 or -28
-17	Hytec II porous junction

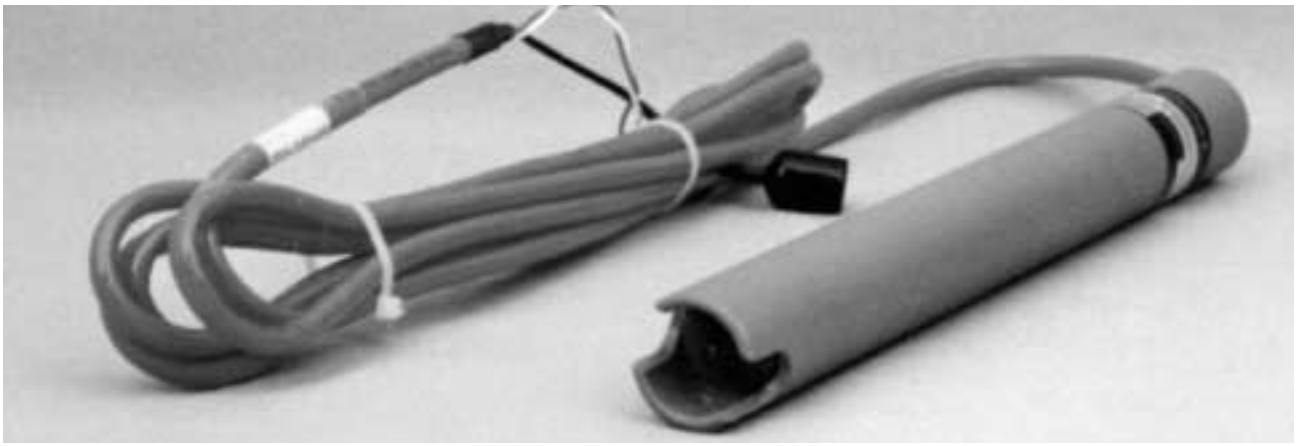
ADD	MOUNTING OPTIONS
-20	CPVC flow cell and insertion fitting, 1½" slip
-21	CPVC flow cell, 1½" FNPT, P/N A2300073
-22	PVDF flow cell, 1½" FNPT, P/N A2300074
-23	316 SS flow cell, 1½" FNPT, P/N A2300075
-26	CPVC Union Insertion Fitting, 1½" MNPT, to 60 PSIG at 90°C (194°F), P/N A2300086
-27	PVDF Union Insertion Fitting, 1½" MNPT, to 90 PSIG and 90°C (194°F), P/N A2300087
-28	SS Union Insertion Fitting, 1½" MNPT, to 90 PSIG and 90°C (194°F), P/N A2300088
-30	Titanium Union Insertion Fitting, 1½" MNPT, P/N A2300089

ADD	TEMPERATURE COMPENSATOR OPTIONS
-31	Temperature compensator, 3K ohm; for pin jacks add (P); for MOEX connector add (MC)
-32	Temperature compensator, 100 ohm RTD; for pin jacks add (P)
-33	Temperature compensator for 655 MICROPROCESSOR; for pin jacks add (P)
-34	Temperature compensator, 1000 ohm RTD; for pin jacks add (P)
-39(x)	Internal Preamp (specify analyzer make & model number)

ADD	APPLICATION & MAINTENANCE OPTIONS
-70(x)	Extra copies of instruction manual (x) qty $ (EA)
-72(x)	Long cable; minimum 6 ft., maximum 100 ft. Priced length (x) times $/ft.
-73	Pulp modified tip, flush surface
-77	Anti-Coating Treatment
-89	Stainless steel tag
-93	Buffer 6-pack: 4, 7 & 10, P/N A1100054. For Pure Water see P/N A1100220-6P
-94	Buffer 4.0 pH, 500 mL, red, P/N A1100051. For Pure Water see P/N A1100216
-95	Buffer 7.0 pH, 500 mL, green, P/N A1100052. For Pure Water see P/N A1100217
-96	Buffer 10 pH, 500 mL, blue, P/N A1100053. For Pure Water see P/N A1100218
-97	Electrode storage solution, 500 mL bottle, P/N A1100090
-98	pH service kit: 1 year supply, P/N A1600050
-99	Special

Appendix O: 642 Spec Sheet

PROCESS COMBINATION



"One of the world's most rugged pH electrodes"

WHY ?

A major Mining company asked IC CONTROLS to design a pH sensor to survive pH measurement problems they had in gutters, sluiceways, and floatation tanks. Rock slurry not only precipitated scale on their pH electrodes; it also hit them (home run fashion) with pieces of lumber and packed broken wood bits around the pH tip. They wanted a robust survivor, easy to remove scale and toothpick like bits packed in around the pH tip. To answer their needs, IC Controls developed the 642 from heavy walled PVC pipe with body extensions to protect the glass pH tip from direct impact. It is rugged! Internally the pH glass was cushion mounted so that impact does not break the glass! To address the scaling, plugging problem it was reasoned that, as a tree root will not plug in soil, a wood junction would not plug in rock slurry, so a wood junction was applied around the pH glass. A 1 inch junction diameter was chosen so a standard screwdriver blade can be used to scrape scale or toothpick bits off the junction or pH glass tip. Finally the pH glass was recessed in a protective pocket of heavy body flutes so it could be dropped on the bottom of a pail of acid for scale removal, or a pot of pH buffer for calibration, or on the floor or gutter bottom, all without breaking. Properly positioned, the body flutes also scoop just enough particulate to wear down scale as fast as it is formed.

RELIABLE SUBMERSION

The IC CONTROLS Model 642 pH Sensor is a low-cost solution to traditional "leakage" problems associated with submersible pH sensors.

The electrode assembly is designed to work with the electronics package located in a junction box above the liquid level. The assembly is completely encapsulated and comes with a standard 10 foot lead. This setup achieves a reliability not previously associated with submersion pH measurement.

FEATURES

- Rugged body constructed from 1" schedule 80 pipe
- Cushion mounted pH electrode resists shocks
- "U" shaped body protects glass tip from breakage during calibration, cleaning and accidental impact
- Open electrode tip for easy cleaning
- Large 1" diameter reference junction surrounding pH tip resists plugging and cuts variations in reading caused by changes in flow direction.

Model 642

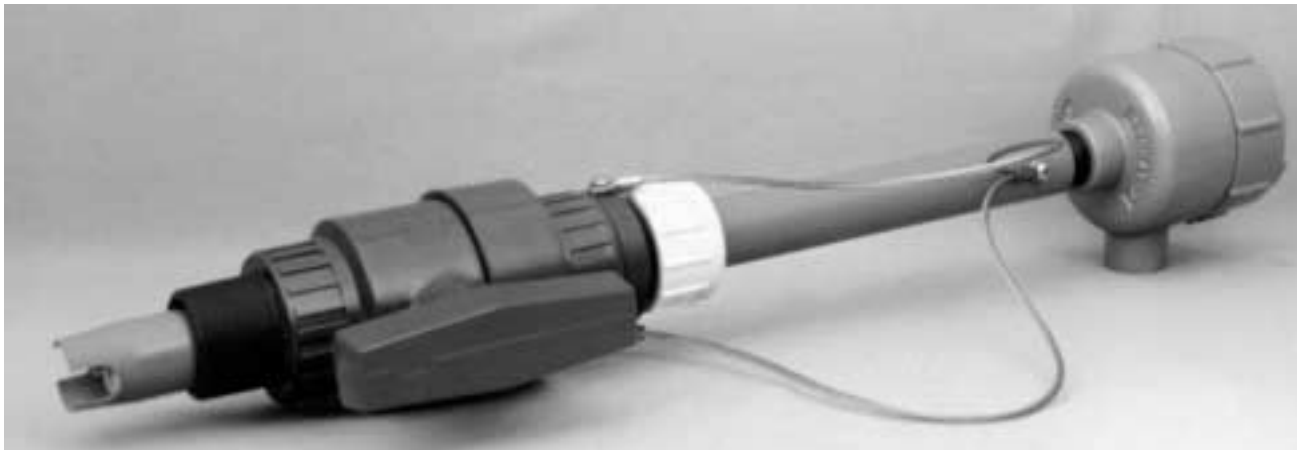
SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL 642	*BASIC DESCRIPTION (Our Best "Survivor"; Industrial, Submersible pH Sensor)*					
	Industrial submersible process combination pH electrode with protected general-purpose tip, 0-12 pH and 10-80°C (50-176°F), annular wood junction reference, sealed self-pressurizing design. Body material CPVC, length 1 ft., process connection ¾" FNPT, lead length 10 ft., fitting BNC. Includes one instruction manual.					
	ADD	*pH ELECTRODE OPTIONS (to change from General Purpose electrode)*				
	-0	Solution ground connected				
	-1	Ruggedized high temperature, 20-105°C (68-221°F), not recommended below 50°C (122°F)				
	-2	Low temperature tip, -5 to 80°C (23-176°F), recommended for -5 to 10°C (23-50°F) applications				
	-3	High pH tip, 0-14 pH, recommended for 10-14 pH applications, 20-120°C (68-248°F) and hot caustic				
	-4(x)	-4(P): Platinum ORP tip; -4(G): Gold ORP tip				
	-5	Extra-rugged tip, 20-130°C (68-266°F), 0-12 pH. Over 105°C (221°F) requires -8 & -12, expect 1-4 wks life				
	-6	Flat Glass tip, 0-90°C (32-194°F), 0-12 pH				
	-7	Double-junction electrode, reference, recommended for contaminating ions in the process				
	-8	Plastic reference, recommended to retard ion depletion and on all applications over 80°C (176°F)				
		ADD	*BODY & JUNCTION MATERIAL OPTIONS*			
		-12	PVDF, maximum 130°C (266°F), with general purpose tip maximum is 105°C (221°F)			
		-16	Hytec I porous junction			
		-17	Hytec II porous junction			
			ADD	*MOUNTING OPTIONS*		
			-21(x)	1" MNPT, tip end threaded for flow tee, specify (x) insertion length beyond threads, (max. 8 inches)		
			-23	2" Flange CPVC Insertion, mounts on standard 2" flanged TEE or NIPPLE		
			-24	1" MNPT outside back end thread for mounting (¾" FNPT inside)		
			-25	24" Swing-Arm body, 3 flutes & pigtail for chain mounted self cleaning action		
				ADD	*TEMPERATURE COMPENSATOR OPTIONS*	
				-31	Temperature compensator, 3K ohm (for 652 Analyzer); for pin jacks add (P)	
				-32	Temperature compensator, 100 ohm RTD; for pin jacks add (P)	
				-33	Temperature compensator for 655 MICROPROCESSOR; for pin jacks add (P)	
				-34	Temperature compensator, 1000 ohm RTD; for pin jacks add (P)	
				-39(x)	Internal Preamp (specify analyzer make & model number)	
					ADD	*APPLICATION & MAINTENANCE OPTIONS*
					-70(x)	Extra copies of instruction manual (x) qty, $ (EA)
					-71(x)	Short cable: maximum of 9 ft.
					-72(x)	Long cable: minimum 11 ft., maximum 100 ft. Priced length (x) times $/ft.
					-73	Pulp modified tip, flush surface
					-76	Sensor Swing-Arm assembly, free standing
					-77	Anti-Coating Treatment
					-78	Tip modified for chemical cleaner, not available with -21, -23, -25, & -73
					-79	Chemical cleaner accessories (pump, nozzle, P/N A2100020), requires timer or 655-51
					-81	Internal refillable reference, useful on 5-100 µSiemen water & some coatings.
					-89	Stainless steel tag
					-93	Buffer mixed 6-pack: 4, 7 & 10, P/N A1100054. For Pure Water see P/N A1100220-6P
					-94	Buffer 4 pH, 500 mL, red, P/N A1100051. For Pure Water see P/N A1100216
					-95	Buffer 7 pH, 500 mL, green, P/N A1100052. For Pure Water see P/N A1100217
					-96	Buffer 10 pH, 500 mL, blue, P/N A1100053. For Pure Water see P/N A1100218
					-97	Electrode storage solution, 500 mL bottle, P/N A1100090
					-98	pH service kit; 1 year supply, P/N A1600050
					-99	Special

Appendix P: 643 Spec Sheet

BALL VALVE RETRACTABLE



"One of the world's most rugged pH electrodes"

The Survivor

A major Mining company asked IC CONTROLS to design a pH sensor to survive pH measurement problems they had in gutters, sluiceways, and floatation tanks. Rock slurry not only precipitated scale on their pH electrodes; it also hit them (home run fashion) with pieces of lumber and packed broken wood bits around the pH tip. They wanted a robust survivor, easy to remove scale and toothpick like bits packed in around the pH tip. To answer their needs, IC Controls developed the 642 from heavy walled PVC pipe with body extensions to protect the glass pH tip from direct impact. It is rugged! Internally the pH glass was cushion mounted so that impact does not break the glass! To address the scaling, plugging problem it was reasoned that, as a tree root will not plug in soil, a wood junction would not plug in rock slurry, so a wood junction was applied around the pH glass. A 1 inch junction diameter was chosen so a standard screwdriver blade can be used to scrape scale or toothpick bits off the junction or pH glass tip. Finally the pH glass was recessed in a protective pocket of heavy body flutes so it could be dropped on the bottom of a pail of acid for scale removal, or a pot of pH buffer for calibration, or on the floor or gutter bottom, all without breaking. Properly positioned, the body flutes also scoop just enough particulate to wear down scale as fast as it is formed.

RELIABLE RETRACTABLE

Now available! The reliability of IC CONTROLS famous Model 642 submersible electrode in a ball valve retractable design.

The IC CONTROLS Model 642 pH electrode is a low-cost solution to traditional "leakage" problems associated with pH sensors. The 643 is a low-cost solution to retraction needs at low to medium pressures.

The electrode assembly is designed to work with the electronics package located in a junction box outside the ball valve and liquid. The sensor is completely encapsulated and comes with a standard 10 foot lead. This setup achieves a reliability and economy not previously associated with retractable pH measurement.

FEATURES

- Retractable through Ball Valve for calibration and/or maintenance.
- Rugged body constructed from 1" schedule 80 pipe
- Cushion mounted pH electrode resists shocks
- "U" shaped body protects glass tip from breakage during calibration, cleaning and accidental impact
- Open electrode tip for easy cleaning
- Large 1" diameter reference junction surrounding pH tip resists plugging and eliminates variations in reading caused by changes in flow direction.

Model 643

SELECTION GUIDE

ORDER BY FAX: (519) 941-8164

MODEL 643	*BASIC DESCRIPTION (Ball Valve Retractable "Survivor" Type pH Sensor)*					
	CPVC Ball Valve Retractable pH electrode with protected general-purpose tip, 0-12 pH and 10-80°C (50-176°F), 50 PSIG, annular wood junction reference, sealed self-pressurizing design. Body length 20", process connection 1½" FNPT, lead length 10 ft., fitting BNC. Includes one instruction manual. Requires option -21 for insertion (or -74 for ball valve retraction).					
	ADD	*pH ELECTRODE OPTIONS (to change from General Purpose electrode)*				
	-0	Solution ground connected				
	-1	Ruggedized high temperature 20-105°C (68-221°F), not recommended below 50°C (122°F)				
	-2	Low temperature tip, -5 to 80°C (23-176°F), recommended for -5 to 10°C (23-50°F) applications				
	-3	High pH tip, 0-14 pH, recommended for 10-14 pH applications, 20-120°C (68-248°F) and hot caustic				
	-4(x)	-4(P): Platinum ORP tip; -4(G): Gold ORP tip				
	-5	Extra-rugged tip, 20-130°C (68-266°F), 0-12 pH				
	-6	Flat Glass tip, 0-50°C (32-122°F), 0-12 pH				
	-7	Double-junction electrode, reference, recommended for contaminating ions in the process				
	-8	Plastic reference, recommended to retard ion depletion and on all applications over 80°C (176°F)				
		ADD	*BODY & JUNCTION MATERIAL OPTIONS*			
		-16	Hytec I porous junction			
		-17	Hytec II porous junction			
			ADD	*MOUNTING OPTIONS*		
			-21	1½" CPVC slip insertion fitting, no ball valve, for Hot Tap, maximum temperature 60°C, P/N A3600013		
			-22	Integral mounted 600 interface in explosion proof UL & CSA J-box, requires -71(12")		
			-23	2" Flange CPVC, -22 mounts through standard 2" flange or TEE flanged		
				ADD	*TEMPERATURE COMPENSATOR OPTIONS*	
				-31	Temperature compensator, 3K ohm (for 652 Analyzer); for pin jacks add (P)	
				-32	Temperature compensator, 100 ohm RTD; for pin jacks add (P)	
				-33	Temperature compensator for 655 MICROPROCESSOR; for pin jacks add (P)	
				-34	Temperature compensator, 1000 ohm RTD; for pin jacks add (P)	
				-39(x)	Internal Preamp (specify analyzer make & model number)	
					ADD	*APPLICATION & MAINTENANCE OPTIONS*
					-70(x)	Extra copies of instruction manual (x) qty, $ (EA)
					-71(x)	Short cable: maximum of 9 ft.
					-72(x)	Long cable: minimum 11 ft., maximum 100 ft. Priced length (x) times $/ft.
					-73	Pulp modified tip, flush surface
					-74	1½" MNPT CPVC ball valve & fittings set for retraction
					-77	Anti-Coating Treatment
					-89	Stainless steel tag
					-93	Buffer mixed 6-pack: 4, 7 & 10, P/N A1100054. For Pure Water see P/N A1100220-6P
					-94	Buffer 4 pH, 500 mL, red, P/N A1100051. For Pure Water see P/N A1100216
					-95	Buffer 7 pH, 500 mL, green, P/N A1100052. For Pure Water see P/N A1100217
					-96	Buffer 10 pH, 500 mL, blue, P/N A1100053. For Pure Water see P/N A1100218
					-97	Electrode storage solution, 500 mL bottle, P/N A1100090
					-98	pH service kit; 1 year supply, P/N A1600050
					-99	Special

IC CONTROLS

Quality Water Analysis Equipment

pH / ORP
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DISSOLVED OXYGEN
CHLORINE
STANDARDS

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CONDUCTIVITY
ANALYZERS

TWO SENSOR
ANALYZERS

CONDUCTIVITY TWO-WIRE
TRANSMITTER

pH ANALYZERS

ORP
ANALYZERS

pH/ORP TWO-WIRE
TRANSMITTERS

ppm DO
ANALYZERS

ppb DO

ppm DO TWO-WIRE
TRANSMITTERS

ppm CHLORINE
ANALYZERS

CALIBRATORS

pH/ORP BASED
CHLORINE